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VOL LXV 10 NOVEMBER 1951 No 1687

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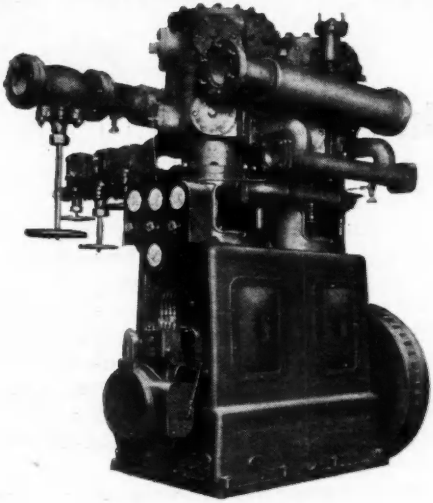

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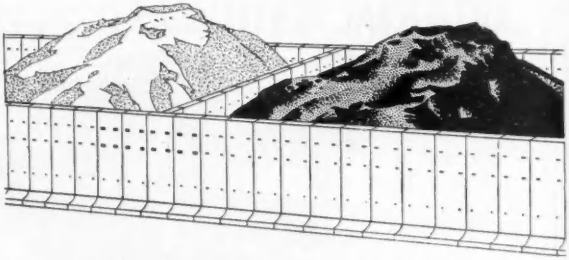

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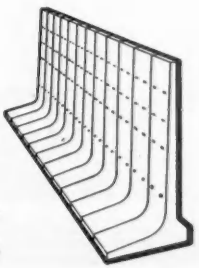

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INDEX TO ADVERTISERS IN THIS ISSUE

	Page
Altrincham Jute, Ltd	648
Black, B., & Son, Ltd.	vi
Boots Pure Drug Co., Ltd.	x
Boydell, E., & Co., Ltd.	Cover iv
British Celanese, Ltd.	xiii
British Electrical Development Association	v
British Iron & Steel Federation	xi
Brotherhood, Peter, Ltd.	i
Bruce, W. T., & Co., Ltd.	648
Burgess Zeolite Co., Ltd.	x
Classified Advertisements	xvi, xvii
Clifford, Charles, & Son, Ltd.	iii
Cuthbert, Ralph, Ltd.	xii
Elcontrol, Ltd.	xiv
Four Oaks Spraying Machine Co., Ltd. (The)	Cover iii
Foyle, W. & G., Ltd.	vi
George, W. & J. & Becker, Ltd.	647
Girling, S., & Sons (Coopers) Ltd.	Cover ii
Glebe Mines, Ltd.	xii
Greenwich Pump & Plant Co., Ltd. (The)	xviii
Guest Industrials Ltd.	Cover ii, iv
Howards & Sons, Ltd.	Front Cover
Kestner Evaporator & Eng. Co., Ltd.	iv
Kilner, John, & Sons (1927) Ltd.	xviii
Laporte Chemicals, Ltd.	Cover iii
Leda Chemicals Ltd.	vi & 648
Leitch, John W., & Co., Ltd.	xv
Lennox Foundry Co., Ltd.	xviii
Manlove, Alliott & Co., Ltd.	vii
Metway Electrical Industries, Ltd	xv
Monsanto Chemicals, Ltd.	viii, ix
Moss, William, & Sons, Ltd.	xviii
National Enamels, Ltd.	Cover iii
Nitralloy, Ltd.	xviii
Nu-Swift, Ltd.	vi
Pascall Engineering Co., Ltd. (The)	Cover iv
Permutit Co., Ltd. (The)	645
Stelcon Industrial Floors, Ltd.	ii
Wells, A. C., & Co., Ltd.	Cover ii
Widnes Welding Co., (The)	vi

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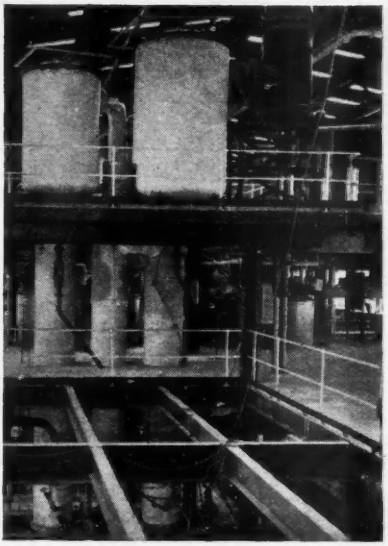

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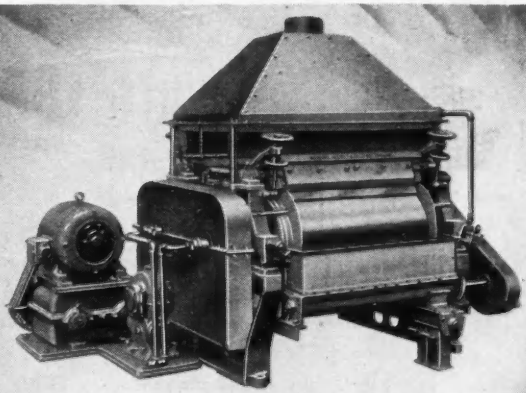

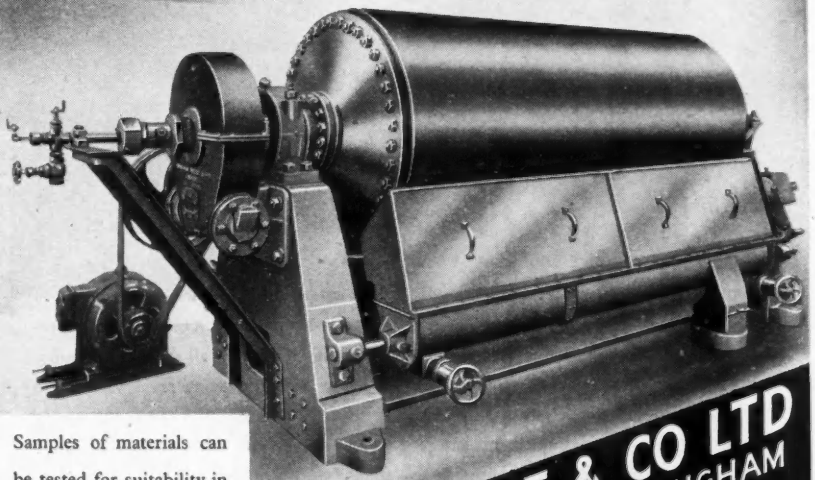

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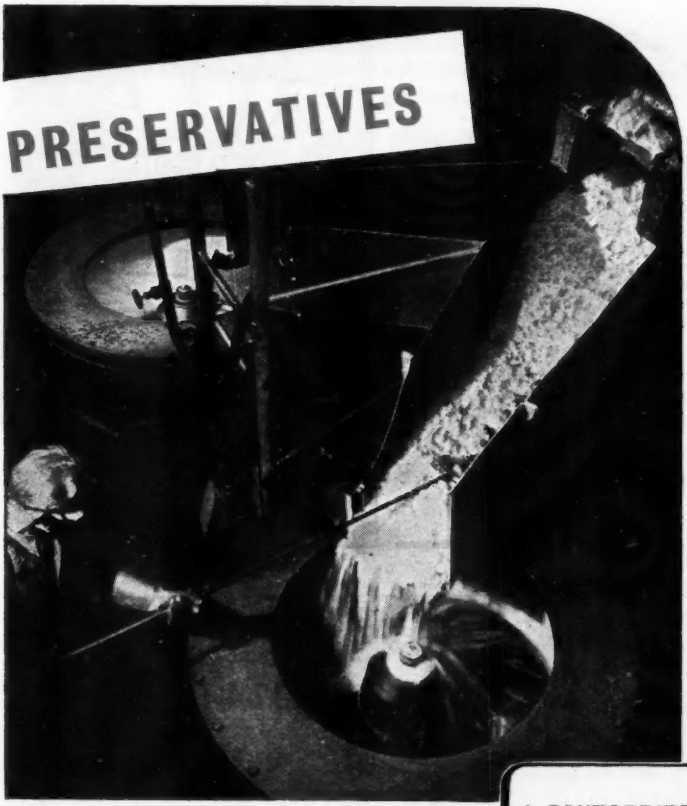

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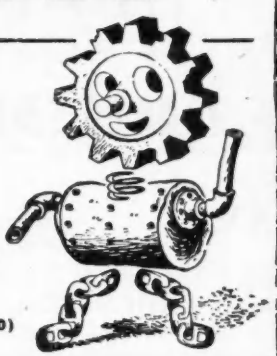

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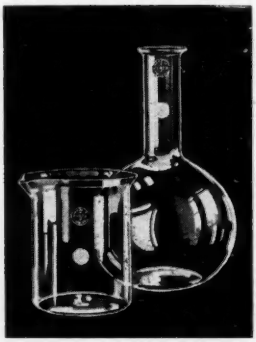

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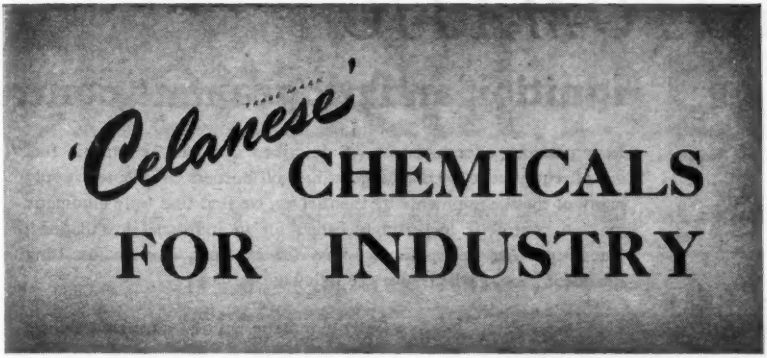

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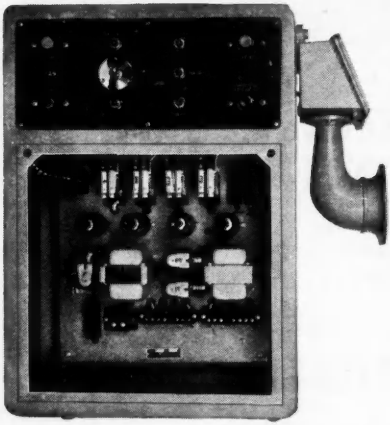

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Volume LXV 10 November 1951 Number 1687

The Chemical Research Laboratory

FEW publications could reveal the changing shape of chemistry better than the latest Report—for 1950—of the Chemical Research Laboratory. A diversity of subject-matter is only to be expected. It is the diversity of research methods that seems so much more difficult to accept; chemistry, a subject that could still be fairly rigidly defined even when middle-aged chemists of today were taking their degrees, no longer has visible borders. It is almost comforting to find here and there in the report a few lines devoted to an intrinsically chemical problem—for example, an examination of a new method for the analysis of arsenic. The traditional type of chemist, probably more pointedly describable today as an obsolete die-hard, might perhaps hope to enjoy himself without ultra-chemical distraction in the section devoted to the work of the Organic Group. But the revolution in chemistry recognises none of the old frontiers; experiments to enrich carbon dioxide with radio-isotopic C^{13} and equations for calculating the ratio of C^{12} and C^{13} in hydrocarbons brutally declare that even organic chemistry is no longer a 'closed shop' for exclusively chemical mentalities. Turn a few more pages and the High Polymers and Plastics Section offers even less hope for escapists; the first two sub-titles are 'The Influence of Polymer Structure on Ion-Exchange Equilibria and Kinetics' and 'Relativity Affinity-Coefficients.' The nostalgic chemist can derive comfort only from the re-use of the word 'affinity' that even then seemed an echo from the grave of alchemy.

As a final death-blow to the old restricted view of chemistry comes the section under Microbiology. If physics, including atomic physics, had not been enough, here is the living world of minute cells spreading beyond its accepted territory of fermentation to provide alcohol or acetone. Here are culture strains from desert lakes south-west of El Agheila harnessed to produce sulphur for sulphur-restricted industries. Here in colder prose than might well have been justified is the story of British chemists on expedition from Benghazi to find a future industrial process in the waters of salt marsh lakes. 'A "desert laboratory" had been designed and made by the C.R.L. workshop. It contained over 60 sampling vessels, special apparatus for sampling water from different depths and mud from the bottom, solutions and apparatus

for sulphide and *p*H determinations, and an alcohol lamp. A microscope was taken for observations on the site. An inflatable dinghy was used for getting to various parts of the lake and sampling.'

All this, indeed, is modern chemical research. It has grown out of the chemistry of twenty-five years ago yet bears only the smallest resemblance to it. If it is somewhat frightening for older chemists who have passed beyond the years when new knowledge can be easily absorbed, it cannot be without some fears for the very young who must now absorb so vast a panorama of different sciences to keep abreast of the chemical front. indeed, the implications for modern education in chemistry seem terrifying indeed. In recent years it has been fashionable to decry early specialisation. But the facts point remorselessly to specialisation unless preparation for a career in chemical research is to take a remarkably long period in normal working and earning life. A commendably all-round knowledge is a criterion for reading and understanding the whole of this report but the workers who have carried out the investigations have clearly had to be refined specialists in particular operations and fields of science.

Considered as a whole the report is a remarkable achievement of British science and a considerable answer to those critics who from time to time suggest that we lag behind some other countries. Not only has a great volume of progress been reported but little of it has been simple or straightforward. Problems of industry have not merely been examined by applying well-established principles of fundamental science; more often than not very new principles have had to be applied and where the problem is particularly intractable new research into fundamental science has been part of the work.

It is to be hoped that no general measures of national economy will be applied to the Chemical Research Laboratory. In more than one part of the report the urgent need for increases in staff and expansion of facilities is referred to. 'These developments require both additional staff and accommodation for their implementation on a satisfactory basis. In particular, the accommodation for the Laboratory is scanty. . . .' 'The staffs engaged on this work (*analytical*) have been so fully occupied with routine analysis during the year that little opportunity has been available for research into the improvement of existing methods or the development of new ones. It has not been possible to provide either the additional staff or space nor in consequence to implement the scheme fully.' Much is said today about economy in State expenditure but it is very clear that here expansion rather than contraction is nationally necessary. Indeed, not the least striking aspect of the report is Appendix II, which lists the names of the C.R.L. staff. It is difficult to believe that so much has been done by so few.

On Other Pages

International Fertiliser Trade . . 619
Sulphuric Acid from Anhydrite . . 621
60 Years of Scientific Research . . 625
Noble Metals in Chemical Apparatus 627
British Firm Making Process Pumps . 629
Analytical Chemistry of Silicon . . 633
Titanium Pigments . . 638
Chemists' Bookshelf . . 639
Home News Items . . 640
Overseas News Items . . 641
Publications and Announcements . . 642
Personal . . 643
Next Week's Events . . 646

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Notes & Comments

A *Sherman Law Verdict*

THE Du Pont Company, Imperial Chemical Industries, Imperial Chemical Industries (New York) and Remington Arms Company, have been found guilty of 'conspiracy of restraint of trade and commerce in chemical products, sporting arms and ammunition, among the several states of the United States and with foreign nations. . . .' Judge Sylvester Ryan, in a 208-page 'opinion' or summing-up, found that the relationships between these companies violated the Sherman Anti-Trust Act. An early result will be the presentation of a 'decree' by the Government and it is suggested in *Chemical Week* that the decree will ask for the compulsory licensing of Du Pont patents, the compulsory transfer of technical information and 'know-how,' and the separation of joint ownerships between the companies concerned. It is said that 900 Du Pont patents and 2,000 ICI patents may be affected as this is the number of respective patents listed as part of the agreements connected with the anti-trust charge.

Assessment Difficult

IT is difficult for British chemists and business men of the industry to assess the significance of this case and its result. The Sherman anti-trust law is entirely American. It would be invidious, therefore, to venture into comment or criticism. We have laws that are peculiarly British and no doubt we should quickly resent American comment upon their operation. It is fair comment, however, to wonder whether the dissemination of technical 'know-how' can, in fact, be made compulsory. To compel the licensing of patents with or without royalty payments is one thing, but it seems quite another to order the additional distribution of detailed technical information about the operation of the processes concerned. A legal demand should be precise, yet it seems virtually impossible to decide precisely where ordinary chemical knowledge ends and the more special 'know-how' type of knowledge begins. Nevertheless, the U.S. Government seems determined to enforce this difficult obligation. It is reported that the decree will specify that competitors will be able to visit Du Pont works and see the processes in operation; and that the Du Pont organisation must provide manuals of information and arrange personal discussions between their executives and those of other companies desiring to license a patent. It remains to be seen whether these indications are confirmed. The decree had to be filed before the end of October. However, the forecast of its requirements has a firmer basis than mere rumour. It has been given in a Press interview with the Attorney-General, who led the Government case.

'Ferralyst' Operating

THE 'Ferralyst' sulphur recovery process (first reported in CHEMICAL AGE, 4 August 1951) is still occasioning a steady flow of inquiries regarding its details and performance. The latest development in this country is a small laboratory-scale 3 ft. reactor which has been set up in the laboratory of Bamag Limited, Rickett Street, London, S.W.6, and has been operating successfully over the past few weeks. This reactor has been operated separately on mixtures of: (1) coal gas, hydrogen sulphide and air; and (2) hydrogen sulphide and air. The rates of flow reached 5,000 volume changes per hour, which was the maximum possible with the laboratory apparatus available. From the test it was verified that the catalyst converted the sulphides successfully to elemental sulphur, which was subsequently collected. With such a small-scale operation the difficulties of measurement are obvious, but Bamag are sufficiently satisfied with the efficiency of the catalyst and with the relatively high space velocity obtained, to build and instrument a pilot plant capable of handling between 500 and 1,000 cu. ft. of gas per hour. It is expected that this unit will be installed on a commercial stream in the near future. It was further demonstrated in the tests that the sulphur does not deposit

on the catalyst, and, in fact, comes off as a very finely divided mist entrained in the gas stream. The catalyst was found to be stable in operation and to be extremely flexible in its ability to operate successfully over a wide range of temperature, rates of gas flow and pressure.

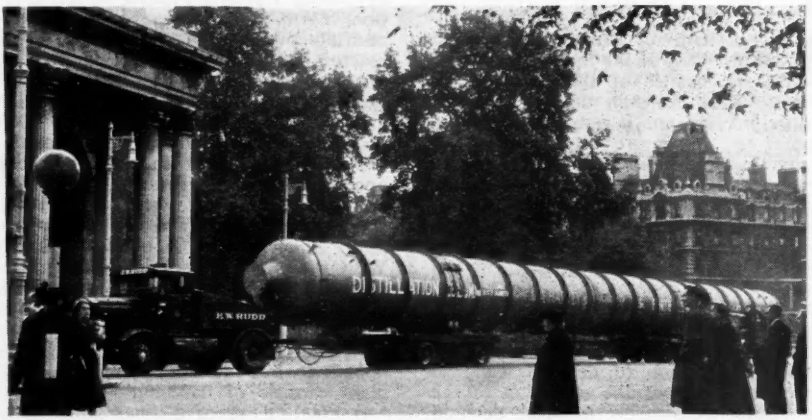
Technical Personnel

SHORTAGE in the supply of chemical engineers combined with an increasing demand for their services has for a long time now presented a problem to which it is hard to find a solution, despite the fact that, according to the report of the chemical and engineering panel of the Ministry of Labour's Technical Personnel Committee a year ago, the number of students in this subject at the universities will be doubled by 1954. The committee rightly insisted that chemical engineering is an applied science in its own right, not merely applied chemistry or physics, and certainly not some arbitrary blend of chemistry and engineering. Fortunately raw material shortages can sometimes be sidestepped, but lack of technical personnel is a far harder problem to overcome. There is an urgent need for any practical measures to alleviate this deficiency and the 'Scheme for a Part Time Course in Chemical Engineering,' proposed by the Institution of Chemical Engineers is therefore welcome.

Part Time Education

NO facilities exist to meet the requirements of students who, although not qualified for either university or diploma courses, have a keen desire to become chemical engineers. It is to meet the needs of such potential members of the profession that the scheme has been put forward by the council of the institution. Success or otherwise of such a project must depend first on demand, and second on facilities. Responsibility for encouraging young people to ask for such training largely depend on co-operation of employers.

The scheme has been designed primarily for holders of Ordinary National Certificates in Chemistry and Mechanical Engineering. The course is for a period of three years involving attendance on three evenings a week, with a fourth Endorsement Year to provide a link between the course and the Associate Membership examination of the institution. The object is to teach a man to think along the right lines, and to make use of reference books.



The distillation column manufactured for Forth Chemicals, Ltd., by G. A. Harvey & Co., (London), Ltd., starting its journey from London to Grangemouth in Scotland. The column is 136 ft. long, 10 ft. wide and 14 ft. 6 in. high and weighs 55 tons

(*see* THE CHEMICAL AGE, Vol. 65, 586)

International Fertiliser Trade

OEEC Summary of Conditions and Regulations

MUCH valuable work in overcoming economic problems and working out a common plan of action to ensure the most effective use of American aid has been achieved by the Organisation for European Economic Co-operation since it was constituted in April, 1948.

Liberalisation of trade and an understanding of trade regulations between its member countries has been one of the main tasks of the OEEC.

Fertilisers, as all goods which enter the market, or are otherwise transferred, are, of course, subject to the general resolutions of the civil and criminal code in each country. Most countries it appears have, however, found it necessary to strengthen the control of trade in this commodity.

A sub-committee on fertilisers, fungicides and insecticides was therefore set up, and a report on and summary of regulations concerning the trade in fertilisers in OEEC countries has now been published.

By spreading the knowledge of the more important conditions under which fertilisers may be produced, imported and sold in the different countries, the sub-committee considered that it might help in promoting international trade. It was also thought that information on the main features of laws at present in force in a number of countries would be of interest to any Governments which might be envisaging new laws on this subject or the amendments of those already in existence.

Finally it was hoped that it would be possible at a later stage to form certain recommendations in regard to general rules that could be adopted by all countries in order to facilitate further international trade in fertilisers.

Authentic to 1951

The documentation used in this report was furnished by member Governments and in most cases the original text of the regulations was available. The chapters and general remarks relating to different countries have, moreover, been revised by the countries themselves. The information is therefore believed to have been authentic at the time when the paper was drafted, that is in the first half of 1951.

Why more stringent control is sought on fertilisers than in some other commodities may be seen from the fact that for the average consumer, it is very difficult to recognise the quality and composition of such a material. On the other hand an unsuitable composition can have detrimental results which may adversely affect not only the farmer, but considering the quantities sold annually, the whole community as well. In some countries, it should also be borne in mind, the money spent on fertilisers reaches about 10 per cent of the total farm expenditure.

Special Regulations

Of the 18 countries considered in the report only four—Austria, Iceland, Sweden and Turkey—have no special regulations. In Trieste the same regulations apply as in Italy. Austria, however, has a new law in preparation which will supersede earlier regulations now abandoned. In Sweden only obligatory methods of analysis are issued by the Board of Agriculture for State and Government-subsidised laboratories. In Iceland a State Monopoly of imports and distribution of all fertilisers dispenses with special legislation.

Regulations on fertilisers are contained in laws or Statutory orders sometimes instituted for fertilisers only but more often jointly with other farm requisites or products. Countries in which regulations are made separately for fertilisers are: the Netherlands, Luxembourg, Germany, Portugal and Greece. In Denmark, the United Kingdom and Ireland, regulations are provided in laws relating to feeding-stuffs also.

In Norway and Belgium the law provides for regulations for the trade in fertilisers, feeding-stuffs and seeds, and in France the law provides regulations for both fertilisers and pesticides. Although the law in Switzerland covers all farm requisites, an order provides prescriptions for trade in fertilisers separately. In Italy the law embraces all farm requisites and a number of processed agricultural products.

In all countries the enforcement of regulations and mostly also the authority to provide detailed prescriptions is left to the Ministry or Department of Agriculture. In

some countries an advisory board is provided by law to assist the administration in its work (for example, in Denmark, the United Kingdom, Belgium and the Netherlands).

Inspection of Premises

Provisions are made in certain countries for the enforcement of the law by inspection of premises where fertilisers are manufactured, stored or kept for sale. In such cases, persons specially authorised may enter such premises and may take samples. This regulation exists in Norway, Denmark, the United Kingdom, Ireland, the Netherlands, Belgium, France, Switzerland, Portugal and Greece.

Some particulars in regulations quoted in the report include the following:—

In Norway and Denmark the content of the three main plant nutritive elements must be calculated as N, P, K, whereas in other countries N, P_2O_5 and K_2O as the basis for indications of the quantitative and generally also for the qualitative content, is required by law or in common use. It appears, however, that in Sweden the same indication is used by general understanding as in Norway and Denmark though without authority of a law. It should, however, be noted that in the Netherlands, for mixed fertilisers the qualitative (not the quantitative) indications for the three plant nutrients must be expressed by N, P, K.

Solubility in water appears to be required by law for phosphoric anhydride accounted for in superphosphates in Norway, the United Kingdom, Ireland, the Netherlands, Belgium, Switzerland and Portugal.

The content of plant nutritive elements of fertilisers or their minimum content is prescribed by law in Belgium, the Netherlands, Switzerland, Portugal and Italy.

Extent of variations for the most commonly used fertilisers is also fixed by regulations in a number of countries and it is noted that they differ considerably.

Limits for certain plant poisons which may not be exceeded are fixed by the Danish regulations. In the Netherlands and in Switzerland the content of chlorine in certain fertilisers is limited. In the United Kingdom and in the Netherlands the content of free acid in ammonium sulphate must be indicated. In Belgium phosphate fertilisers other than basic slag exceeding a content of 10 per cent sesquioxide must carry the indication 'iron'—or 'aluminium phosphate'.

The 18 member countries of which the trade regulations are summarised are: Iceland, Norway, Sweden, Denmark, the United Kingdom, Ireland, the Netherlands, Belgium, Luxembourg, France, Germany, Switzerland, Austria, Portugal, Italy, Trieste, Greece, and Turkey. The report forms one of the series recently inaugurated under the title 'OEEC Documentation' dealing with specialised technical studies, concerned more especially with industrial and agricultural subjects likely, in present circumstances, to be of particular interest from the point of view of European economy.

Canadian Research

TWO leading research scientists have been appointed to take charge of Canada's experimental stations in the west where effort is being intensified in conjunction with the re-armament drive.

The Defence Department has announced that Dr. Hugh Massey Barrett is returning from England to resume his duties as chief superintendent of the Suffield experimental station, Ralston, Alberta, and Dr. Donald B. W. Robinson has been appointed to the superintendency of the Defence Research Northern Laboratory, Churchill, Manitoba.

Dr. Barrett, who is 43, was appointed head of the chemistry division at Suffield when it was established in 1941. When he came to England two years ago he took over the post of chief superintendent of the chemical establishment at Porton from Dr. E. A. Perren who was loaned to Canada in his place. Dr. Barrett was awarded the O.B.E. in 1946.

Dr. Robinson joined the staff of Suffield experimental station in 1942. He spent four years there in research before going to England on a Rhodes Scholarship for a year's work at Oxford.

First U.S. Quartz Discovery

Up to now, the U.S. has been dependent for her supplies of specification quartz crystal on foreign sources—mainly Brazil. A short time ago, however, prospectors discovered a source of quartz on a plateau at 9,000 feet in northern Utah. This is the first discovery of its kind in the U.S. To stimulate the development of the deposits, which lies in the Goshute Indian Reservation, the General Services Administration has already contracted to buy the entire output of the mines for the next 12 months.

Sulphuric Acid from Anhydrite

Process, Cost and Development Reviewed

NEED to increase the quantities of sulphuric acid from indigenous raw materials so that Great Britain might be less dependent on imported materials for one of her most essential commodities was emphasised by Dr. John Manning, F.R.I.C., in a paper read before a meeting of the Fertiliser Society, held at Caxton Hall, London, S.W.1, on Thursday last (8 November).

The following is an abstract from Dr. Manning's address describing the cement-sulphuric acid process and its development.

About three-quarters of the sulphuric acid Great Britain needs are made from imported raw materials and it appears that this acid, on which our chemical and other industries rely, is dependent chiefly on foreign sources of supply. The only raw material which is not subject to limitation and has not to be imported, is anhydrite which is at present used only for comparatively minor quantities of acid.

The amount of acid produced from anhydrite was 5.9 per cent of the total in 1949 and 5.6 per cent of the total in 1950. In 1949 the amount of acid from indigenous materials was 22 per cent of the sulphuric acid produced in Great Britain, in 1950, 20.7 per cent.

Anhydrite is not a rare mineral, but a common substance which occurs abundantly throughout the world. Chemically it is calcium sulphate. Its density is from 2.8-3, its hardness between 3 and 3.5, harder than gypsum, and its crystals belong to the rhombic system but it does not usually occur in a crystalline form.

Calcium sulphate minerals of Great Britain are of three age groups, Jurassic, Triassic and Permian.

Situation of Deposits

Anhydrite is present, sometimes with gypsum, not only in the north-west, north-east and centre but also in southern England. No deposits of any size are indicated in Scotland and it is only found in the south-east of Wales. Deposits of gypsum and anhydrite occur, however, in Ireland.

Mines for anhydrite are at Billingham in County Durham and near Carlisle. Over 1,000,000 tons a year are being brought to the surface and used for industrial purposes, chiefly for the manufacture of ammonium sulphate but also for sulphuric acid.

For over 20 years there has been a plant at Billingham which uses anhydrite as a source of sulphur for sulphuric acid and is producing acid at a rate of approximately 100,000 tons a year. This plant has been making quantities of acid of this order for a number of years now, and at the same time a similar tonnage of cement of British standard specification.

Complex Process

The cement-sulphuric acid process is somewhat complex and involves the decomposition of anhydrite with the assistance of two or three reagents. Anhydrite is a stable substance and resists being broken down into its constituents. It is not readily decomposed by heat alone and it is necessary to go well above 1,200° before decomposition becomes appreciable.

It is the combination of anhydrite decomposition with silica and alumina together with carbon which is the basis of the existing cement-sulphuric process. In this process the decomposition of calcium sulphate with carbon is the first step

$$CaSO_4 + 2C \rightarrow 2CO_2 + CaS.$$

This is followed by the reaction of the calcium sulphide with calcium sulphate

$$3CaSO_4 + CaS = 4CaO + 4SO_2$$

and this last reaction is assisted by the presence of acidic oxides which form compounds with the lime and prevent the reaction in the reverse direction. If sufficient silica and alumina are added and if these are in the correct proportions, then it is possible to obtain a cement clinker from the decomposed anhydrite mixture.

Initially there must be just sufficient carbon to give the quantity of calcium sulphide which is required to reduce the remaining calcium sulphate. An excess of carbon gives too much calcium sulphide which resists desulphurisation and too little leaves some calcium sulphate undercomposed. The proportions of silica to alumina and of alumina to iron and of lime to silica must also be within certain limits if the cement is to be produced to British standard speci-

fication and in addition there is of course the temperature of the reactants to be kept correct.

There are reactions other than those already mentioned and there are also side reactions. Silica can react with calcium sulphate directly at a slightly higher temperature than the carbon reaction to decompose anhydrite giving essentially sulphur dioxide and a silicate. Alumina can react by itself similarly with anhydrite. Reactions can also take place between sulphur dioxide and calcium sulphide, between sulphur dioxide and carbon and also between sulphur dioxide and calcium oxide. Carbon monoxide can also be formed which in turn would bring about other reactions.

Early Problems

Consequently it is not surprising that when this process which was described by Muller in 1926 (Ref. *Z. angew. Chem.*, 1926, *39*, 169) was tried out on plant scale at Leverkusen it met with very considerable difficulties. Several other processes with anhydrite had met with lack of success. There were the plants at Bernburg, Walbeck, Neckarzimmern, Waldhof, Duisberg which had all been run on a comparatively large scale but were not able to continue production.

Difficulties existed in incomplete decomposition, corrosion, physical character of the reactants, and, associated with these, the cost of production. The experimental plant at Leverkusen was followed by work in this country and in 1929 a cement-sulphuric acid plant was erected at Billingham and production started in 1930. There were initially troubles and during the early 1930's there was some liaison with the Germans and a little later they started their own plant at Wolfen.

Production from the Billingham cement-sulphuric acid plant has risen from 10,583 tons in 1930 to 101,023 tons in 1950. Plans are in progress to extend capacity to 175,000 tons H_2SO_4 a year. To help alleviate the present U.K. shortage of sulphur a new plant with a capacity of 150,000 tons a year is being constructed on Merseyside, but will not be completed until 1954.

Other cement-sulphuric acid plants known in Europe are at Wolfen, Germany, with a present capacity of 85,000 tons a year to be increased to 175,000 tons by 1955; Miramas, France, now restarted and in full production with 25,000 tons a year capacity, and a new plant installed this year at Wizow, Poland, capacity unknown.

In this country the cement-sulphuric acid process is based essentially on the work of Muller and Kuhne in which part of the anhydrite is decomposed to the sulphide by carbon and the reaction of this sulphide with the residual anhydrite is aided by the presence of acidic oxides, alumina and silica, in the correct proportions to form cement.

If only the main lines of the process are considered it consists of five stages which are (a) preparation of raw materials, (b) reactions in a rotary kiln, (c) purification of the gases, (d) conversion of the sulphur dioxide and gases to sulphuric acid, (e) conversion of the kiln clinker to cement.

The raw materials are anhydrite and sources of alumina and silica in suitable proportions. The latter two can be obtained from marl and sand or from clay and sand. Ashes of coal and coke contain alumina and silica and the analyses of these can be adjusted by additions to give a mixture containing the correct proportions of Al_2O_3, SiO_2 and CaO. Quite clearly since it is necessary to control a number of constituents in the mix within comparatively narrow limits, it is essential to have raw materials which do not vary greatly in composition.

Before mixing, the raw materials are dried and are then stored in separate bunkers from which predetermined weights can be taken. These materials are weighed out on to a band and conveyed into grinding mills. Although the mixtures are of different hardnesses, sufficiently correct mixing can be obtained in the course of the passage through the mills. The ground raw meal, as it is then called, passes to storage bunkers from which samples are taken to check the analyses. It is necessary to have storage at this point of the process to ensure the continuous running of the kilns which form the next section of the plant.

Kiln Reaction

Raw meal passes from the bunkers direct into the rotary kiln which is similar in a number of respects to an ordinary cement kiln. It is in this kiln that the constituents of the mixture combine together. The first step of the reaction is probably the reduction of anhydrite with coke. Then follows the decomposition of the anhydrite by calcium sulphide.

Finally any residual calcium sulphate reacts with the silica which also combines

with the lime and alumina present to form a cement clinker. If too much sulphide is formed, the clinker will contain a high sulphide and will be unsuitable for cement. The mixture inside the kiln in the firing zone will become plastic and damage the lining of the kiln; there will also be a tendency to form rings.

If on the other hand too little calcium sulphide is formed, a high proportion of calcium sulphate will be in the material entering the firing zone and a mixture of this composition has a comparatively low fusion point giving rise to a very corrosive liquid, which will readily destroy the lining of the kiln.

Pulverised coal is used to fire the kiln. The ashes mix with the reactants and must be taken into account in proportioning the raw materials; the temperature of the kiln is slightly higher than that for a normal cement kiln. The gas containing 9 per cent SO_2 together with nitrogen and carbon dioxide and a little oxygen passes from the kiln to the sulphuric acid section. The clinker at the opposite end of the kiln after having gone through the firing zone falls through recuperators, where it is cooled, and then passes on to the cement works for grinding, packing and export.

Gas purification is similar to that adopted in a pyrites sulphuric acid plant. Dust is first removed in cyclones and the gas still containing appreciable proportions of dust is then cooled in wash towers. Further quantities of dust are removed in these towers from which the water is taken and the dissolved sulphur dioxide removed by passing the water counter current to a stream of air. The sulphur dioxide containing air joins the main gas stream.

Water Removal

Cooled humid gases still containing some dust and mist are treated with electrostatic precipitators and the gases then are substantially dust free and optically clear. The next stage of purification is water removal, which is done by counter current scrubbing with sulphuric acid.

The gases leaving the drying towers are cool, dry and free from impurities and their SO_2 content is reduced from 9 to about 6½ per cent by the introduction of air containing SO_2 from the cooling towers and air itself to obtain sufficient oxygen for the conversion of the sulphur dioxide in these gases to sulphur trioxide and sulphuric acid. The gases first pass through blowers and it is these blowers which govern the suction on the kiln. The gases are blown through heat interchangers by which they are heated to temperatures just over 400°C. by outgoing gases and through converters containing platinum or vanadium catalyst.

Heat Interchange

Conversion is probably best carried out in several stages with temperature regulation between each lot of catalyst and this is conveniently done by heat interchange with the incoming gases or steam generation. The converted gases are taken to an absorption system where sulphur trioxide is absorbed in 98 per cent sulphuric acid which is diluted by drying tower acid to give an R.O.V. product containing about 96 per cent H_2SO_4.

Since the gases contain only about 6½ per cent SO_2 it is usually necessary to have some type of tail gas plant so that the sulphur dioxide-containing gases passing into the atmosphere do not constitute a nuisance. One method of absorbing the sulphur dioxide in the exit gases is to scrub with ammonium hydroxide.

Sulphur dioxide in contact with ammonia in solution forms ammonium bisulphite-ammonium sulphite solution which is circulated round the exit scrubbing tower and by suitable *p*H control very little ammonia is lost and the sulphur dioxide in the exit gases is reduced to about 2/3 grain/cu. ft. measured as equivalent sulphuric acid. The ammonium bisulphite liquor is decomposed by sulphuric acid to give sulphur dioxide which is led back into the system at the inlet to the drying towers and an ammonium sulphate solution which on evaporation yields a by-product, ammonium sulphate.

Capital costs of cement-sulphuric acid are high. They consist essentially of the costs for a cement plant and a pyrites sulphuric acid plant, but the output from the kiln is less than from a normal cement kiln and, consequently, the capital slightly greater than that of a pyrites sulphuric acid plant plus that of a cement plant. If the capital cost of a pyrites plant is estimated to be £18/ton year, then that of a cement-sulphuric acid plant would be £25 to £30/ton year.

These are round figures; the actual cost of a plant would of course depend on the locality and the availability of services and so on, and for a smaller plant the cost per

ton-year SO_2 would be much higher. The capital required for the kiln plant appears roughly equal to that for the acid sections.

Cost of acid is, of course, largely dependent on the price obtained for the cement. If the cement is sold locally so that freight charges are minimised, then a substantial profit is made on the cement which can be credited to the acid production. Alternatively, some profit can be taken on the cement capital and the remainder credited to the joint process producing sulphur dioxide and clinker. Anhydrite and its freight contribute more than any other material to the cost. Consequently the mining cost must be low and the mine near to the sulphuric acid plant. If the freight on anhydrite was £1 a ton, the total increase in cost would amount to £1.66/ton of H_2SO_4.

In conclusion, Dr. Manning expressed his thanks to the directors of the Billingham Division of I.C.I., Ltd., for permission to publish the paper, and to Mr. N. E. Murlis who assisted in collecting the data.

Industrial Employment

Figures for Chemical Trades

EMPLOYMENT of persons associated with the chemical and allied trades in Great Britain at the end of August totalled 497,000, an increase of 3,000 over the previous month and 13,000 more than at the end of 1950, according to the analysis of civil employment in the *Ministry of Labour Gazette* (Vol. 59, No. 10).

Changes in the level of employment on the industrial analysis relate to employees only and exclude employers and persons working on their own account. The total numbers in Great Britain employed in the chemicals and allied trades (in thousands) were 492.0 in August, compared with 489.5 in July and 439.5 in mid-1948.

Detailed distribution (in thousands) was as follows: Coke ovens and by-product works 17.5 (16.9 men, 0.6 women); chemicals and dyes 221.8 (168.3 men, 53.5 women); pharmaceutical preparations, etc., 42.2 (17.4 men, 24.8 women); explosives, etc., 41.1 (26.8 men, 14.3 women); paint and varnish 40.1 (28.5 men, 11.6 women); soap, candles, polishes, etc., 55.1 (31.6 men, 23.5 women); mineral oil refining 40.8 (34.2 men, 6.6 women); other oils, greases, glue, etc., 33.4 (26.2 men, 7.2 women).

In metal manufacture there was also an increase in the total for August being (in thousands) 534.4 as against 432.9 in July this year, and 519.0 in mid-1948.

Non-metalliferous mining products other than coal employed the following numbers (in thousands): 330.7 August, compared with 328.8 in July 1951 and 307.0 in mid-1948.

Placing of work of the employment exchanges during the four weeks ended 29 August, 1951, showed that the following vacancies were filled in the chemicals and allied trades: Total 4,833; men (18 and over) 2,464; boys (under 18) 447; women (18 and over) 1,144 (girls under 18) 778. In the treatment of non-metalliferous mining products other than coal placings during the period totalled 3,455.

The total number of persons enrolled on the Technical and Scientific Register at 18 September, 1951, was 5,385. This figure included 3,835 registrants who were already in work but desired a change of employment, and 1,550 who were unemployed. During the five-week period 14 August to 17 September, 1951, the number of vacancies notified was 1,302. Vacancies filled were 304 and 544 were cancelled or withdrawn.

Harmonious conditions have long been a feature of the chemical and allied trades and during the first nine months of 1951 there were only three industrial disputes, the lowest figure shown in the analysis of industries in the U.K.

Fatal industrial accidents in September, 1951, were fewer than in the previous month, the total of 107 comparing with 121 in the previous month and a revised figure of 220 in September 1950, when the Creswell colliery disaster occurred.

Deaths in the chemicals, oils, soap and allied industries numbered only three. Metal industries had the worst total of nine (extracting and refining, one; conversion and founding, six; other metal trades, two).

No deaths were recorded in the U.K. in September under the Factories Act, 1937, or the Lead Paint (Protection against Poisoning) Act, 1926. Total cases reported were 37. Details were: lead poisoning, four; mercurial poisoning, one; anthrax, two; epitheliomatous ulceration (skin cancer) 18 (pitch 12; tar, five; oil, one); chrome ulceration 13 (manufacture of bichromates, four; chromium plating, six; other industries, three).

Sixty Years of Scientific Research

Chemical Problems Tackled by Philips' Laboratories

IN 1891 at Eindhoven, in the Netherlands, Gerard Leonard Frederick Philips opened an incandescent-lamp factory and was joined four years later by his younger brother, Anton Frederick. From this modest beginning with a capital of 75,000 guilders, has grown the vast organisation of the group of Philips Industries as it is to-day.

The wide scope of scientific research undertaken during the firm's 60 years and the problems investigated range from the incandescent lamp to construction of the synchro-cyclotron installed in the Institute for Nuclear Research, Amsterdam, which continuously produces deuterons with an energy of 28,000,000 electron volts.

Some idea of the multifarious activities of the Physical Research Laboratory is summarised, in the form of an illustrated story, by Dr. W. de Groot, in a special Diamond Jubilee issue of 'Philips Technical Review' (Vol. 13, No. 1-2) edited by the Research Laboratory of N.V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands, published monthly in English, French, German and Dutch.

To say that all the chemical problems tackled in the Philips laboratory emanated, in the course of time, from the incandescent lamp, would be, perhaps, a slight exaggeration, but for a very large part, such is indeed the case, either directly or indirectly.

Tungsten Evaporation Problem

Disregarding the metallurgy of tungsten and the making of the glass, in the manufacture of the incandescent lamp other problems arose including the evaporation of the tungsten, the investigation of which formed an introduction to further research into the adsorption of tungsten atoms and the resultant absorption of light.

Investigation into the vaporisation of CaF_2 led to other compounds such as H_3BO_3 and K_2BF_4 being tried out, as a result of which the volatility of various compounds was studied, and this again led to important technical consequences.

In the Philips laboratory it was found that dissociation of WCl_6 at elevated temperatures takes place also without hydrogen; attempts were made to produce other metals in the pure state in this way. Perhaps the most striking result was the preparation of titanium, zirconium, hafnium and thorium from their iodides by precipitating the latter on a thin tungsten wire as core.

Welding Rod Manufacture

Knowledge of metals and their interaction with gases proved to be of great value to the laboratory staff when it was decided to manufacture welding rods, while the study of tungsten wire and the behaviour of tungsten in processing, led to extensive research in the domain of recrystallisation.

When it became evident that large quantities of luminescent materials would be needed for lighting purposes, Philips began to study the phenomenon of luminescence, in which it was found that physical and chemical problems were so often closely interwoven as to be almost inseparable.

Chemical results lay in the deeper insight gained into the properties of zinc sulphide and related compounds and of substances such as Zn_2SiO_4-Mn_2SiO_4 and manganese phosphors.

Work has also been carried out in the field of organic chemistry proper, namely, in that of compounds with large molecules, such as gelatine, cellulose, proteins and synthetic resins.

Artificial resins were originally studied with a view to the possibility of using these materials for making the bases of radio valves and loudspeaker baffles, and later for making various parts and the cabinets of radio sets.

A third group of organic compounds, the diazo compounds, was intensively investigated in the Philips laboratory when production was contemplated of dye-line paper, in addition to the mercury lamps destined for the dye-line process. With the aid of these compounds in various carriers, such as cellophane, paper, cellulose esters, and so on, materials for photographic reproduction were produced.

Attention was also given to the study of various colloid problems. One result of these investigations, which was of importance in the manufacture of radio valves, was a new method of coating cathodes with

a layer of oxide, covering them by means of electrophoresis with finely distributed carbonates of barium and strontium, which were afterwards turned into oxides.

Development of research in the last decade is less easy to evaluate. All work naturally suffered a check when on 10 May, 1940, the Netherlands were invaded and Philips' works at Eindhoven came under military occupation, which lasted for four years.

In 1950, a second floor was built on to the oldest single storey part of the laboratory, first erected in 1922. This addition to the building was to be devoted mainly to chemical work.

Aided by experience acquired with high tensions and in collaboration with the technical-physical laboratory of the Technical University at Delft, an electron microscope with a magnetic electron-optical system was constructed.

Finally, nuclear physical research has led to the construction of neutron generators with ion-accelerating tube (maximum voltage 1.2 MeV) and also a synchro-cyclotron, with which, for instance, deuterons can be accelerated to an energy of 28 MeV; this synchro-cyclotron has been installed at Amsterdam.

Research Fellowship

Canadians Invite Overseas Applications

THE National Research Council of Canada has announced that it will award approximately 39 post-doctorate fellowships for scientific research in 1952-53. Of these, 34 are for research in pure chemistry and physics to be carried out in the Councils' laboratories at Ottawa, and five are for research in biochemistry, microbiology, and related fields to be carried out in the Prairie Regional laboratory, University of Saskatchewan, Saskatoon.

Applicants should have Ph.D. degrees from recognised universities or should expect to obtain such degrees before the award goes into effect. However, exceptions may be made in special cases. There are no restrictions as to the nationality of the applicant but all Canadian immigration requirements must be met.

The fellowships are for a one-year period, but applications for a renewal for a second year will be considered. For single applicants, the stipend is $2,820 (approximately £940), and for married applicants it is $3,300 (approximately £1,100). The award is tax free and a grant-in-aid of travelling expenses will be made to persons from abroad.

Research fields of interest to chemists in the Ottawa laboratories are: chemical kinetics and photochemistry, surface and colloid chemistry, molecular spectra, low temperature calorimetry, organic chemistry with special reference to alkaloids, mechanism of organic reactions, absorption spectra of organic compounds, physical and thermodynamic properties of gases, and critical temperature phenomena and liquid structure.

Those topics of interest at the Saskatoon laboratory include fermentation chemistry and enzymology, carbohydrate chemistry, and chemistry of vegetable oils and fats.

Applications should be made on a special form that may be secured from the Secretary, Laboratories Awards Committee, National Research Council, Ottawa, Canada, or from the Chief Scientific Liaison Officer, National Research Council of Canada, Africa House, Kingsway, London, W.C.2. Applications and supporting documents should be received in Ottawa not later than 15 February, 1952. If possible, successful candidates will be notified not later than 1 May, 1952. The appointments may be taken up by arrangement at any time thereafter, but preferably in September or October.

New Nitrogen Fixation Plant

AFTER three years' experience with a pilot plant, the Food Machinery Company of America has decided to apply commercially the Daniels process for the direct oxidation of atmospheric nitrogen, in a plant to be built at the Sunflower Ordnance by next year. The problems of achieving the 2,100°C. reaction temperature for this process with gas and air, of developing a refractory to withstand that temperature (specially prepared magnesium oxide), and of cooling the gas stream at a rate of 20,000°C. per second have, it is announced, been solved. In the process the reactors produce 2 per cent nitric oxide which is adsorbed and catalytically oxidised on silica gel. The present plan is to produce nitrogen tetroxide for direct sale or conversion to nitric acid, but by changing reaction conditions, nitric oxide, nitrogen dioxide or nitrogen pentoxide could be produced. The first two may find a use as a rocket fuel.

Noble Metals in Chemical Apparatus

Some Recent German Constructional Materials

SO much progress has been made in recent years in the production of highly resistant steels and alloys, chemically resistant glass, enamels and ceramics, to say nothing of rubber and plastics, that the role of noble metals in the construction of chemical apparatus might at first sight be thought to be an ever-declining one. But despite the progress referred to, these metals still occupy first place when it comes to corrosion-resistance, and special forms of them are constantly arising as new processes and new chemicals are introduced. It is only too likely that progress here is outstripping that relating to resistant steels, alloys and coatings, and the designer of chemical apparatus for use under new and highly corrosive conditions has no other choice than to use the noble metals, alloyed perhaps with one or other of the rare metals. This aristocratic alliance between the noble and the rare metals constitutes a highly interesting and important field in alloy research, on which much work is now being done—the metallurgist is only too familiar now with the extraordinary results often occurring from the presence of little more than traces of certain elements in his alloys.

Some Noble Metals

The noble metals comprise chiefly gold, silver, and members of the platinum group. In many ways tantalum also closely approximates to their quality, in view of its strong resistance to mineral acids (except HF), but its use is largely limited to relatively low temperatures not exceeding about 300° C. Generally this group, in which platinum is probably the most important, combines high resistance to corrosion with good mechanical and engineering properties. They can be readily shaped or worked to complicated forms, are easily repaired—for instance by welding—have good thermal conductivity and their waste value is, of course, fairly high. Usually they must be employed sparingly, *i.e.*, in the form of coating or cladding, as it would be out of the question to use them as bulk metal.

Some interesting examples of the part played by noble metals in the design of chemical apparatus have been given in some of the CIOS and BIOS reports, quoted by, among others, Johannes Schatz, of Frankfurt (*Chemische Ind.*, 1951, *3* (7), pp. 389-391). In the manufacture of hydrogen peroxide, one stage consists in concentrating dilute sulphuric acid (about 35 per cent) up to 63 per cent, when certain parts of tubing in the apparatus are exposed to hot concentrated acid and residual per-compounds. They must at the same time be easily shaped or formed, and have good mechanical properties. The most suitable material for this has hitherto been a gold-silver alloy, but another noble metal alloy introduced recently by Degussa, of Hanau, under the name of 'Pallacid' is said to be more satisfactory and more economical in that it is said to save 63 per cent of the initial cost.

Caustic Alkalis

Among the more aggressive and corrosive chemicals, as is only too well known, are the caustic alkalis, especially when hot. A highly resistant material used in Germany is PK silver-plated steel, which includes a small amount of nickel. This material is both mechanically strong and able to withstand fairly high temperatures—up to 400° C. By means of special welding technique its use in the construction of chemical apparatus is further widened.

Among the most important and also the most expensive of the noble metals used in this field is platinum, generally used in its purest form or alloyed with other platinum metals (palladium, iridium) for plating or cladding. It is particularly useful in (a) reactions under high pressures and temperatures in an acid medium, (b) anodes for electrochemical processes in highly corrosive media, as in the electrolysis of per-compounds. In such cases it is often employed in the form of wire or gauze, or platinum-plated copper or silver plate or wire. The main question to be decided is the thickness of coating necessary for the job. Another important application of platinum or platinised material is in the manufacture of nozzles for various purposes, including those required in the production of glass fibre, for example, where temperatures may be up to 1400° C., and other conditions also are severe.

In cases where the noble metals may have

to compete with other materials that, for the particular purpose in question, may be nearly as or equally suitable as far as heat- and corrosion-resistance are concerned, the decisive factors will be life of apparatus and quality or purity of product; and it may frequently happen that these will turn the scale in favour of the noble metals even if the initial cost is somewhat higher. This is the case, for example, in vessels used for the production of photo-gelatine and for the melting of hydroquinone, where silver-plating is generally preferred, since risk of contamination of the product is thus reduced to a minimum. Another example is afforded in the heating of purine derivatives with dilute hydrochloric acid. An enamel-lined vessel of 500 litres capacity costing £400 had a life of about six months under the very severe conditions of working; a vessel of silver-plated steel costing £900 has been working 1½ years without deterioration.

In the production of some of the newer drugs and of vitamins, etc., the noble metals are finding further applications as plating or cladding for apparatus. In some exceptional cases, of course, where plating is difficult and complicated, it may prove more costly than to make the apparatus from massive metal, *e.g.*, in the construction of silver cooling coils.

The following table gives an approximate idea of the cost of plating with noble metals in Germany, at prices ruling at about 1 May, 1951 (per square metre).

Thickness in mm.	Silver 'PK-Silver'		'Pallacid'		Au/Ag 70/30		Platinum	
	Wt. in kg.	Cost	Wt. in kg.	Cost	Wt. in kg.	Cost	Wt. in kg.	Cost
0.05	—	—	0.65	£148	0.79	£246	1.07	£1207
0.08	—	—	1.03	£236	1.26	£393	1.71	£1930
0.1	1.05	£11-10	1.29	£296	1.58	£491	2.14	£2415
0.5	5.25	£57	6.45	£1480	7.87	£2449	10.70	£3554
1.0	10.5	£115	—	—	—	—	—	—
1.5	15.7	£171	—	—	—	—	—	—
2.0	21.0	£200	—	—	—	—	—	—
3.0	31.5	£343	—	—	—	—	—	—

German Chemical Books

Catalogue From 1939 to 1950

A CATALOGUE of German books on chemical and cognate subjects (1939-1950) is now available on request from Lange, Maxwell & Springer, Ltd., London. This work by A. E. Cummins, Librarian of the Chemical Society and his assistant, Miss S Vince, is a second revised and extended edition of the first volume by Hamilton McCombie and A. E. Cummins, published by the Chemical Council, which included books published from 1939 to 1946.

In a preface to the new edition the compilers point out that many new titles have been supplied by a librarian in Germany who desires to remain anonymous. He recast the work in subject form, and his divisions have been retained by the present revisers, who have thoroughly checked the list with the earlier edition and inserted a considerable number of titles for the sake of completeness. Many of the items are out-of-print, but second-hand copies of some will be available.

A new feature is the introduction of many titles known to be in active preparation, most of which have been published during 1951. Key letters indicating names of publishers have been omitted, partly because some of them no longer exist, and also because the list is now issued by a firm of publishers with such wide connections that they can readily track down any book which is required.

The new edition contains 13 sections, as follows:—

General, theoretical and physical chemistry; inorganic chemistry; organic chemistry; colloid chemistry; chemical analysis; geochemistry and crystallography; food, physiology, pharmacognosy, and pharmaceutical chemistry; chemical technology (subdivided into 11 sections); metallurgy; metallography, mathematics for chemists; and physics (sub-divided into four sections). There is also an author index.

Copies of the publication are being supplied free to scientific and industrial libraries which may be interested.

British Firm Making Process Pumps

Big Orders from Home and Overseas Refineries

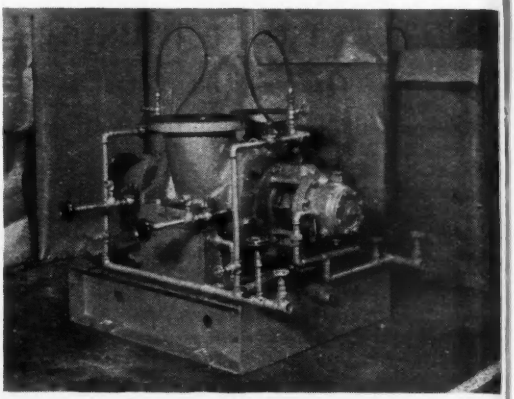
ONE of the first contracts placed with Sigmund Pumps, Ltd., after their entry into the oil refinery process pump field was for a series of pumping units for the Shell Cardon Refinery in Venezuela and last week a handful of senior representatives from the technical Press were given the opportunity of seeing a most interesting batch of pumps awaiting delivery for the extension of this refinery. At the same time the Pressmen were able to see for themselves the care and skill which goes into the design and manufacture of this type of equipment, for they spent several hours touring the firm's new factory at Team Valley, Gateshead-on-Tyne.

Sigmund Pumps, Ltd., having been one of the leading manufacturers of pumps in Europe, decided to commence manufacture of their equipment in the United Kingdom in 1938, but the advent of the war necessitated a radical change of policy, resulting in extremely rapid expansion of manufacturing capacity in order to complete the large Government contracts. The original plans were shelved and during the war only a small number of pumps were sold to industry.

In 1945 pre-war contracts of the old Czech company (which has now been nationalised by the Communists) were renewed in many overseas centres and overseas agents were appointed. At the same time, in view of the highly competitive conditions in Great Britain for standard pumps, it was decided to extend the Sigmund range by entering the field catering for the oil refining and chemical industries. As the Americans had practically a monopoly on these, this move was welcomed, and since then more than 350 types have been made and Sigmund pumps are now in use in refineries at Stanlow, Shell Haven, Venezuela, Holland, France, Fawley, Grangemouth, Llandarey and Abadan. They are also in wide use in petrochemical and other chemical plants and pumps of capacities up to 4,000 g.p.m., pressures up to 1,500 p.s.i. and temperatures varying from sub-zero to 900°F., are being regularly supplied for a wide range of duties. It is the firm's proud boast that not a single prototype has ever been made and that all pumps have been sold direct from the drawing board.

As the majority of pumps are typical process types, and the very nature of operating conditions necessitates ease of maintenance and dismantling, all parts are machined to fine tolerances so that parts of all pumps of the same type will be interchangeable. A standard feature of all pumps is that the whole of the impeller and shaft assembly

Technical Press representatives discussing the merits of one of the Sigmund pumps destined for the new Shell refinery in Venezuela. In the centre is Dr. W. F. Riester, the firm's designer and director in charge of sales



A single stage double entry impeller type pump awaiting shipment. This unit manufactured of stainless steel, is for a duty of 1460 U.S.g.p.m. crude oil product against a pressure of 590 feet at 570°F. Operating speed 3550 r.p.m.

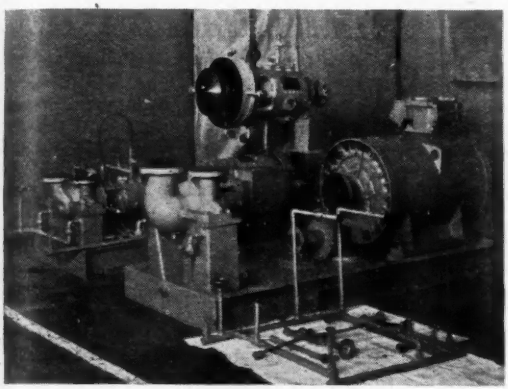
(*Courtesy Sigmund Pumps Ltd.*)

can be withdrawn without breaking any joints in the pipeline and without affecting the alignment of pump or driver.

Fire and explosion risks are, of course, extremely high when handling high octane fuel, propane, naphtha and the many similar liquids having a low flash point. These liquids are pumped through the refinery lines, in many cases at temperatures well above flash point. In all cases, therefore, the number of pressure joints is kept to a minimum, and the pumps are fitted with a harness of pipes feeding cooling water to the bearings and glands, the latter being of the smothering type and thus effectively reducing any element of risk. A special sealing oil system is also provided for all glands. In addition, flow meters and thermometers are fitted to warn immediately of any breakdown in the cooling and sealing system.

For arduous duties such as those for which these pumps are destined, the selection of materials and careful inspection at all stages of manufacture are essential for success in this field. For this reason, the pumps now lying in the Sigmund shops for the Shell contract are of all steel or special alloy cast iron construction, according to the duties for which they are required. A further method of extending the working life of these pumps is the incorporation of shaft sleeves and casing and impeller wear rings manufactured of high duty steel and hardened by means of stellite or calmoney

Mr. P. Cahn-Speyer, editor of 'The Engineers' Digest' inspects one of the pumps being checked in the test bay before shipment



Two single-stage overhung impeller type pumps for operating at a temperature of 480°F. and for handling gas oil product. The impeller and shaft assembly of the pump in the foreground has been removed for final inspection after test at 3550 r.p.m.

(Courtesy Sigmund Pumps Ltd.

deposits, fused to the parent material by a method in which Sigmunds have specialised, and then ground and polished to a superfinish. Hardness of this deposit may be as high as 1,000 Brinell.

Temperatures are in most cases rather high, up to 800°F., and apart from all other considerations the expansion factors of materials used have to be given careful consideration, as otherwise parts could work loose or be crushed by the great forces generated.

All pumps, except the crude charge pumps, will operate at 5,600 r.p.m. At these speeds the heads generated may be as high as 900 ft. in one wheel and the impeller tips are rotating at a peripheral speed of 230 ft./sec. which is considered the limit possible at present for materials available for these conditions of temperature and/or corrosion.

The use of these high speeds is advisable in order to minimise the number of parts in each pump, to simplify construction, and to ease maintenance problems by making quick assembly and dismantling possible. It will be appreciated that this is of utmost importance, when the stoppage of a pump may lead to a stoppage of the refinery unit, with not only a consequent loss of considerable amounts of money, but also hazards of failures of other parts of the units, such as furnaces, which, at the temperatures involved, may coke up quickly when flow ceases.

Test on actual operating liquids and temperatures is not possible before despatch, but in each case the pumps have been tested handling water, at atmospheric temperatures, at the operating speed and under conditions calculated to simulate the hydraulic duties which the pumps are required to give on site.

Among the types on show during the visit were HO-QUA6. These are both double entry type single impeller pumps for crude reboiler charge duties and each is designed to handle 2,060 U.S. g.p.m. of topped crude at a temperature of 600°F., against a head of 395 ft. Their operating speed is 3,550 r.p.m. requiring a 300 b.h.p. driver. The casing is 18/8/3 stainless steel vertical split and suitable for a hydrostatic test pressure of 300 p.s.i. The casing and impeller wearing rings are in Langalloy 4R, the impeller wearing rings being hardened. The im-

Fusing stellite on a stainless steel shaft sleeve to give it a hard wearing face

peller is of 18/8/3 steel, the shaft of EN19 steel with shaft sleeves of 18/8/3 steel stellited.

Sigmund Pump Type 20/10/6 is a barrel type high pressure process pump in which the impellers are housed in a steel casing and surrounded by liquid being handled under discharge pressure thus equalising the pressure on the internal parts of the pump and reducing the pressure joints to two, one only being under full pressure. The pump is designed to handle 50 g.p.m., propane at 110°F. against a differential head of 950 ft., and is built of cast steel throughout.

Two New Isotopes

REVIEWING the progress of nuclear physics in his address to the Royal Institution, London, on 2 November, Sir John Cockcroft, head of the Atomic Energy Research Establishment, Harwell, said that a 'very exciting new phase,' was now beginning in which an attempt was being made to discover the nature of the forces between the so-called elementary particles constituting matter.

Two new isotopes of gold, with isotopic weights of 201 and 202, Sir John disclosed, had been discovered by Dr. Butement and Mr. Shilloto, who had been using high energy neutrons from the 180,000,000 electronvolt cyclotron at Harwell.

Investigations with high energy quanta produced by the electron synchroton carried out by Dr. Titterton and Mr. Brinkworth, two other members of the Harwell research team, were also mentioned by Sir John.

Tracers Determine Clothes Wear

The latest use of radioactive tracer isotopes in the U.S. may be for finding out the fate of 'labelled' cellulose in such things as cotton fibre, rayon, cellulose acetate yarns in clothes; wood, photographic film, plastics, lacquers, explosives, cellophane and paper. The behaviour of the cellulose under varying conditions of wear, weather, sunlight, age and fungi will be studied and conclusions drawn about the many varied problems that concern the mechanism of clothes wear, rotting wood, ageing paper, etc. The radioactive cellulose is prepared by cellulose-producing bacteria which are fed with radioactive sugars.

Uranium from Gold Ores

Prospectors Offered Higher Prices

DISCUSSIONS are being held in South Africa between representatives of the U.S.A. and the U.K. Governments and the Union authorities on the production of uranium from gold-bearing ores. These talks, it is announced by the Ministry of Supply, are a continuation of those held in the Union earlier. The representatives are: United States—J. C. Johnson, F. W. McQuiston, and A. A. Wells (United States Atomic Energy Commission); United Kingdom—F. C. How, J. G. Bower, and R. A. Thompson (Ministry of Supply), and T. V. Arden (Chemical Research Laboratories).

Higher prices are also being offered for uranium ores and concentrates—in some cases 100 per cent higher—to prospectors in the colonies and dependent territories. The offer does not apply in the U.K.

Reasons for the higher prices are the general increase in prices of metals since the Ministry's original offer in March, 1949, and the increased prices now offered by the United States and Canada.

The new minimum prices for contained uranium oxide (delivered c.i.f. to a plant or United Kingdom port) range from 25s. a lb. for ore containing not less than 20 per cent uranium oxide to 35s. a lb. for ore containing not less than 10 per cent uranium oxide. The original minimum offer was 13s. 9d. a lb. of uranium oxide delivered f.o.b. ocean port.

Development Bonus

As an additional incentive, a development bonus equal to the purchase price will be paid for the first five tons of uranium oxide from previously unworked deposits, and capital may be provided for processing plants.

No guarantee can be given by the Ministry to buy less than one ton of uranium oxide—for example less than 10 tons of 10 per cent concentrate, or less than 500 tons of 0.20 per cent ore. The offer is also restricted to pitchblende ores and their secondary derivatives no guarantee of purchase being made for refractory uranium ores that cannot be treated by simple acid-leaching plants.

The Ministry is also willing to discuss purchase terms for thorium-bearing minerals.

MIDLANDS ANALYTICAL METHODS DISCUSSION GROUP

The Analytical Chemistry of Silicon

THE topic chosen by Mr. H. Thomas, of the Research Department, The English Electric Co., Ltd., Stafford, for presentation to the Midlands Analytical Methods Discussion Group at a recent meeting in Birmingham, was 'The Analytical Chemistry of Silicon'.

Silicon is widely used in industry and occurs, for example, in glass, steel, alloys, minerals and so on. As would be expected, a variety of methods are available for the opening-out of silicon-containing materials. Most methods depend on decomposition by means of fluxes.

Opening-out. The more common fluxes used are sodium carbonate, sodium hydroxide, sodium peroxide and sodium borate.

Relevant details of fusions involving these fluxes are as follows:—

Sodium Carbonate. The silicon-containing sample (1 g.) is fused with sodium carbonate (4-6 g.) in a platinum crucible. Should the sample contain reducing substances such as sulphides or arsenides, the sodium carbonate is mixed with a small amount of sodium nitrate, chlorate or peroxide. It is not advisable to use the lower melting mixture of sodium and potassium carbonates, except when chlorine or fluorine are to be determined in the melt and it is desired to prevent volatilisation of the alkali halide. In fact, potassium salts tend to pass into precipitates and are a definite source of error.

Powerful Flux

Sodium Hydroxide. This is one of the most powerful of the available fluxes and must be used in crucibles of nickel, silver or iron, as it attacks platinum. The normal procedure is to fuse the sodium hydroxide gently, cool, add the sample and re-fuse. Despite this, some insoluble matter often remains due to the particles of the sample being blown either to the sides or the lid of the crucible. Koenig (1939) prevented this by adding a few drops of alcohol, thus wetting the individual particles with an alcoholic solution of sodium hydroxide, and then evaporating to dryness before fusion.

Sodium Peroxide. Here, again, is a very powerful flux which is invaluable for the decomposition of substances which are difficult to fuse, such as ferrosilicon and chrome ore. Occasionally nickel or iron crucibles are used for the fusion, but these have a short life.

Parr Bomb Method

Muehlberg (1925) suggested that this be overcome by using a modified Parr bomb method in which the sample is intimately mixed with sucrose carbon and sodium peroxide in a nickel crucible and the mixture ignited. Other workers have investigated the mechanism of the peroxide decomposition and have shown that such decomposition can be carried out in platinum if the temperature is not allowed to exceed 500°C.

Finely powdered mineral is mixed with sodium peroxide in the proportion of 1 : 4 in a platinum crucible and covered with a thin layer of peroxide. The crucible is then placed for seven minutes in a muffle maintained within the temperature range of 480°C. ± 20°C. The crucible is then quickly cooled and the sintered cake dropped into 50-100 ml. of cold water. The cake rapidly dissolves in the alkaline solution formed or on adding acid to the suspension. Zirconium crucibles have been recommended for the peroxide fusions.

Sodium borate. This is not a much used flux, although it has proved useful in the decomposition of chromite and zircon. The main disadvantage is that the boron introduced into the solution must be removed before the classical analytical separations can be carried out.

Potassium bifluoride has been used to open up tantalates, columbates and zircon when constituents other than silicon are being determined. The silicon is, of course, removed during the fusion, although it must be remembered that a number of metallic fluorides are volatile. The fusion is carried out in platinum.

Mixed fluxes have also been used. A mixture of sodium peroxide and sodium hydroxide is an extremely powerful flux, while a mixture of lime and sodium carbonate often proves useful in special instances.

Silica may be determined by evaporating a hydrochloric acid solution of the sample to dryness and dehydrating the residue by baking at 110°C. This process renders the

silica insoluble. Complete dehydration of the silicic acid is not achieved by one evaporation and baking, and even after two evaporations with intervening filtration, some silica remains in solution. Further evaporations will not yield more silica, as a solubility equilibrium is eventually reached.

Most of the remaining silica is carried down with the ammonia precipitate, and in work of the highest accuracy, this silica must be recovered by ignition of the precipitate and subsequent fusion with sodium bisulphate. Even so, some alkali is lost. The silica is ignited to constant weight at about 1,200°C., but the residue is generally impure, and the true amount of silica is obtained by evaporating with hydrofluoric acid and a few drops of sulphuric acid, when the silica is volatilised as silicon tetrafluoride. The purpose of the sulphuric acid is to prevent the loss of volatile fluorides such as titanium and zirconium. The residue is then ignited to convert the impurities to oxides.

Alkalis Form Silicates

Alkalis and alkaline earths must be absent, as they tend to form silicates. On treatment with the hydrofluoric and sulphuric acids, these silicates are broken down and the metal impurity will be finally weighed as sulphate instead of oxide, thus giving low results.

If tungsten is present, the final ignition must be carried out at a temperature not exceeding 850°C. to prevent volatilisation of tungstic oxide. In this method, boron must be removed before dehydration of the silica, otherwise it would volatilise as boron trifluoride with the silicon. This is accomplished by adding methyl alcohol to the solution to be evaporated, when the boron is removed as methyl borate.

It is a common fallacy that some loss of silica occurs during the evaporation with hydrochloric acid. Only in the presence of fluorine is any loss encountered. Some silica is often removed from glass if glass vessels are used for the evaporation, especially during fuming. Nevertheless, glass vessels are much used, although it is advisable to have the glaze unbroken and to run a blank.

The above method involving evaporation with hydrochloric acid and dehydration at 110°C. is very tedious and efforts have been made to obtain a more effective and more rapid dehydration. Sulphuric acid has been used as a dehydrating reagent, but this has the disadvantage that insoluble sulphates separate out. Some workers add caustic potash during sulphuric acid dehydration to prevent contamination by the insoluble metal sulphates (for example, Al, Cr, Fe) by formation of the corresponding alum. It is known with certainty that chromium contamination is obviated in this way, but considerable doubt exists as to the behaviour of aluminium and iron with this treatment.

In this respect it should be remembered that an early method for the determination of potassium involved the addition of a strong solution of aluminium sulphate to the unknown potassium solution, so that it is unlikely that the caustic potash procedure is satisfactory for aluminium. Ferric iron behaves similarly. Gooch (1913) used acetic anhydride as a dehydrating agent, but this does not appear to offer any advantage.

Willard and Cake (1920) used perchloric acid for the evaporation. It can be used for all silicates, metals and alloys, which are acid soluble, with no danger of insoluble salts being formed. Again, the method is useful when lead, barium, strontium, calcium and so on are present; that is, where the sulphuric acid method is unsatisfactory.

Briefly, the procedure is to dissolve the metal or silicate in hydrochloric or nitric acid, and, after adding perchloric acid, to evaporate to dense fumes, boil for 20 minutes, cool, dilute and filter. The salts are instantly soluble and the silica can be filtered off and determined in the usual way, with little or no contamination. Perchloric acid is often without action on silicates which are not decomposed by hydrochloric acid. Insoluble silicates must first be subjected to a fusion technique. Two perchloric acid dehydrations are necessary to ensure satisfactory results. It may be noted that the B.S. method for the determination of silicon in iron and steel uses a perchloric acid dehydration.

Sodium Hydroxide Employed

The classical method of determining silicon in aluminium alloys due to Regelsberger (1891) employs a sodium hydroxide attack on the sample. The silicon is thereby converted to silicate which is determined in the usual way. Two dehydrations are

necessary, however, for complete recovery of the silica.

In the method of Fuchshuber (1939, 1943) mixed phosphoric, sulphuric and nitric acids are used to attack the aluminium alloy and to convert the silicon present to silicic acid which is then dehydrated by evaporation of the solution, addition of hydrochloric acid and re-evaporation. Osborn and Clark (1947) introduced a cobalt salt to indicate complete dehydration, thus preventing solution of silica in phosphoric acid. Other workers do not favour the use of the cobalt indicator, as the colour change involved is not sharp.

Silicon in the presence of fluorine cannot be determined by the above methods as on evaporation of the acid solution, silicon is lost as silicon tetrafluoride. In the Berzelius-Hillebrand method (1919), the sample is fused with sodium carbonate and extracted with water. Most of the silica in the aqueous extract is precipitated by addition of excess solid ammonium carbonate and allowing to stand for a few hours. The precipitate is filtered off and washed with ammonium carbonate solution. After evaporating to small bulk, the silica remaining in the filtrate is precipitated with ammoniacal zinc oxide. The silica in the precipitates is then recovered by dissolving in acid and dehydrating the silica in the usual way.

When a silicate containing a fluoride is fused with boric oxide, no loss of silica occurs, as the fluorine is expelled as boron trifluoride. This has been made the basis of a method for the determination of silica in the presence of fluoride.

Fluorspar Rapid Analysis

A paper by Shrenk and Ode (1929) describes the rapid analysis of fluorspar. The sample is decomposed with 20 per cent perchloric acid saturated with boric acid at 50°C. The mixture is heated to fumes and the dehydrated silica determined in the usual way. The temperature should not fall below 50°C. even during filtration, otherwise the boric acid will come out of solution, causing contamination of the precipitate.

Silicic acid can be flocculated by gelatine in the presence of sulphuric or hydrochloric acids and the silica obtained after ignition is so pure that treatment with hydrofluoric acid is unnecessary. In addition, the filtrate is completely free from silicic acid. This principle has been used by Geigenmüller (1942) as the basis of a method for the determination of silicon in silumin alloys. The method has been incorporated in a modification of Regelsberger's procedure for the determination of silicon in aluminium alloys. This was extensively used in Germany during the last war and the procedure with slight improvements may be detailed as follows.

Procedure

The sample (0.5 g. for 10-40 per cent Si; 1 g. for 5-10 per cent Si; 2 g. for < 5 per cent Si) is placed in a stainless steel beaker and solid caustic soda (5 g. for 0.5 g. samples, 6-7 g. for larger samples) added; 10 ml. of water are added and the beaker covered with a nickel lid. When the violent reaction has abated, 50 ml. of water are added and the solution boiled gently. (For alloys containing more than 20 per cent Si, the sample should be attacked with 15 ml. of 30 per cent caustic soda followed by 5 g. of sodium peroxide). The solution is transferred to a beaker containing 60 ml. 1 : 1 sulphuric acid or 120 ml. 1 : 1 hydrochloric acid for a 2 g. sample, half quantities of acid for smaller samples. The beaker and lid are then rinsed with warm 1 : 9 hydrochloric acid, and any copper, etc., is dissolved by adding, in portions, 10-15 ml. of hydrogen peroxide.

Boiling of the mixture takes place until the final volume is 50 ml for a 2 g. sample, 40 ml. for smaller samples, and it is cooled to about 60°C. Next, 40 ml. of gelatine solution (0.25 per cent dissolved in warm water and sterilised by adding a few pea-sized crystals of thymol to the rapidly cooled solution) is added, followed by 20 ml. of water for 2 g. samples, 10 ml. for smaller samples. The mixture is then stirred to form a froth, and air stirred in, after which it is allowed to stand for 10 minutes, when it is filtered through a medium speed filter (for example, Whatman 40), and the precipitate washed six to eight times with hot water containing about 20 ml. of gelatine solution and 10 ml. of 1 : 1 hydrochloric acid per litre. The precipitate of silicic acid is then ignited and weighed.

Kordon (1945) developed a rapid titrimetric method for the determination of silicon in iron and steel. The silicon is precipitated as potassium fluosilicate, which is titrated with standard alkali, the following reaction taking place:—

$$K_2SiF_6 + 4KOH \rightarrow 6KF + Si(OH)_4$$

Hence a good conversion factor is obtained, 1 ml. 0.1N KOH ≡ 0.7 mg. Si.

The precipitate is slightly soluble, but the solubility may be decreased to a satisfactorily low value by precipitating from either saturated potassium fluoride solution or a less expensive potassium chloride solution containing a little hydrofluoric acid, with subsequent washing with a saturated potassium chloride solution.

Although barium fluosilicate is less soluble than the potassium salt, it cannot be used here, as it adsorbs acids which are difficult to wash out; again, it is not readily decomposed by alkali.

Kordon's Methods

Kordon developed methods for the determination of silicon in pig iron, plain carbon steels, and tungsten and tungsten-free steels. The determination on a plain carbon steel may be carried out in 15 minutes. Travers (1921) first used the fluosilicate method for determining silica in silicate rocks, and, while he obtained slightly high results, he overcame interference due to aluminium.

Silicic acid forms an intense yellow heteropoly complex with molybdate ions within a certain *p*H range, and in the absence of reducing agents. The optimum *p*H for the formation of the complex is about 1. Phosphate ions gives a similar colour under these conditions, but the interference can be overcome by precipitating the phosphate as calcium phosphate, or, better, by destroying the phosphomolybdic acid complex with oxalic, tartaric, or citric acids.

Silica standards are reported to be stable if kept in hard rubber bottles. Winkler, as early as 1914, proposed potassium chromate solutions as standards and these solutions buffered with borax are now used as standards in this country.

Sensitivity of the method can be increased by reducing the silicomolybdate to the well-known molybdenum blue. Many reagents have been suggested to effect the reduction, for example, stannous chloride, hydroquinone and benzidine, the last named giving an increased sensitivity due to the concomitant formation of the meriquinoid compound benzidine blue. The B.S. method for the determination of silicon in steels employs the method of Gentry and Sherrington (1946) who used ferrous ions in the presence of oxalic acid as reductant, in this way preventing interference by phosphorus, arsenic and vanadium.

The extraction procedure of Berenblum and Chain (1932) is of interest in that it furnishes a method, developed by Milton (1951), for the determination of arsenic, phosphorus, silicon and germanium in the presence of each other. Thus, silicomolybdate is formed in 0.1N sulphuric acid and reduction with stannous chloride effected in 2N sulphuric acid. The molybdenum blue is then extracted with butyl alcohol or acetate and estimated.

If the residual solution is then adjusted to 1.2N with respect to sulphuric acid, phosphomolybdate is reduced and the molybdenum blue can be extracted and estimated. Reduction of the acidity of 0.9N allows the germanomolybdate to be reduced and estimated. Finally, arsenic, which has been maintained in the tervalent state, may be oxidised, when it forms the arsenomolybdate which can then be estimated after reduction with stannous chloride.

Some workers experience trouble when sodium sulphite reduction and butyl extraction procedures are employed, due to the formation of a slight sediment which interferes. No such trouble is found with stannous chloride, the reductant recommended for normal purposes.

Berg and Teitebaum (1928) developed a titrimetric method for the determination of silicon. The yellow silicomolybdate complex was allowed to react with excess oxine to form a crystalline precipitate which was treated with an excess of potassium bromate. The excess was back titrated iodometrically. Merz (1941) brominated the excess oxine and titrated the excess bromate iodometrically.

Pyridine as Precipitant

Pyridine was suggested as precipitant by King and Watson (1936), and Mika (1944) used it for the determination of silica in steel. Precipitation of the silicomolybdate complex was carried out in dilute nitric acid solution and the complex formed then dissolved in an excess of 0.1N alkali, which was then back-titrated with 0.1N acid using phenol red as indicator.

Duval (1947) developed gravimetric and titrimetric methods using hexamine as precipitant. The method of Brabson *et al.* (1948) is noteworthy. They used oxine as precipitant and could determine silicon in the

presence of fluorine, if boric acid was added to complex the fluorine.

Procedure is briefly as follows:—

(i) *Cryolite or Fluorspar.* Fuse 0.5 g. with 8 g. of sodium hydroxide. Extract with water, and wash the crucible first with hot water and then with dilute hydrochloric acid. Digest just below the boiling point for 10 minutes with 2 ml. of 30 per cent hydrogen peroxide. Cool and add 8 g. of boric acid.

(ii) *Phosphate Rock.* After fusing a 0.5 g. sample, dilute to 200 ml. and add concentrated hydrochloric acid until the precipitated hydroxides and phosphates just dissolve. Dissolve 0.5 g. of boric acid in the solution, dilute to 500 ml. and add 50 ml. of this solution to 2.8 g. of sodium hydroxide in 120 ml. of water.

Add eight drops of thymol blue indicator, then concentrated hydrochloric acid dropwise until the colour changes from yellow to red. Add 8 ml. of 10 per cent hydrochloric acid, 5 ml. of 1 : 2 acetic acid and 20 ml. of 10 per cent ammonium molybdate solution. Stir the solution between addition of the reagents and vigorously for one minute after addition of the molybdate. Allow 15 minutes for the formation of the silicomolybdate complex. Add 40 ml. of 1 : 1 hydrochloric acid and precipitate the silica immediately by adding 60 ml. of oxine solution (14 g. oxine, 20 ml. of 6N hydrochloric acid, diluted to 100 ml., filtered, diluted to litre) from a burette, stirring constantly during the addition

Heat at 60°C. for 10 minutes stirring occasionally. Allow the precipitate to settle and filter through a sintered glass filter. Wash 10 times with wash solution (12 ml. glacial acetic acid, 143 ml. concentrated hydrochloric acid, diluted to 2 litres and saturated with oxine-silicomolybdate) and once with water.

Dry at 140°C. Phosphorus precipitates quantitatively with the silica. Wt. of P_2O_5 = Wt. of oxine-molybdophosphate × 0.03174. Wt. of SiO_2 = Wt. of oxine silicomolybdate × 0.02410.

Oxine Substitution

Arsenic, vanadium, germanium, titanium and germanium interfere, the last two by hydrolysis. Wilson (1949) used quinoline in place of oxine, while other workers have suggested trimethylamine and triethylamine.

Organo-silicon compounds with boiling point less than 200°C. may be determined after fusion with peroxide in a Parr bomb. Materials with boiling point above 200°C. may be wet-oxidised. In this latter case, if the oxidant is volatile, the final ignition to silica may be carried out without further transference of the sample. If ignition is carried out in an atmosphere of oxygen, there is no likelihood of silicon carbide being formed.

One of the problems of analytical chemistry is the differentiation between free and combined silica. It is possible that fusion with fluoboric acid or pyrosulphate will take out free silica.

There is, as yet, no method for the determination of silicon, silica and silicate in presence of each other. If the mixture is treated with dilute hydrochloric acid, the silicon is not attacked and may be filtered off, treated with concentrated alkali and the hydrogen evolved measured. Silica and silicon may be determined in presence of each other by differential volatilisation with hydrofluoric acid. The silica is volatilised first and the silicon remaining is oxidised with nitric acid and the volatilisation repeated. Fusion with bisulphate will give total silica and silicate.

U.S. Manganese Experiments

SUCCESSFUL production of electrolytic manganese with a purity of 99.9 per cent from low-grade ore from the Three Kids Mine, Las Vegas Wash, Clark County, Nevada, by use of a chloride electrolyte is described in a progress report recently released by the United States Bureau of Mines.

Although previous experiments, conducted in the Bureau of Mines Electrometallurgical Laboratory at Boulder City, Nevada, had resulted in successful electro-winning of manganese, there was an indication that a chloride process might have certain advantages over a sulphate process. This report contains the result of the use of the chloride process tested on a semi-pilot-plant basis.

The report includes details of the crushing, grinding, roasting processes, the solution purification, and data pertaining to the electrolysis. While no economic comparison between the sulphate and chloride process is offered, it was indicated that the latter would be more difficult and expensive to operate. The reference number of the report is 4817.

Titanium Pigments

Physical Methods & Quantitative Analysis

TITANIUM pigments were the central theme of papers and discussion at the 33rd ordinary meeting of the physical methods group of the Society of Public Analysts and Other Analytical Chemists held at the William Newton School, Norton, on Friday, 19 October. This was a joint meeting with the Tees-side section of the Royal Institute of Chemistry and was preceded by a visit to the new research laboratory of British Titan Products, Ltd., at Billingham.

Paper Presented

The following papers were presented and discussed:—

'Physical Methods in the Titanium Pigment Industry.' By F. R. Williams, Ph.D., F.R.I.C.

The pigment industries produced not so much a commodity as a series of physical properties, for example, high refractive index, high reflectance in the visible spectrum, and so on. The presence of impurities could modify these considerably, and in view of the extreme difficulty of taking titanium dioxide into solution physical methods were of necessity employed to a considerable extent both in routine and in research. The necessity for these was enhanced by the modification of the chemical properties of some other elements by the presence of titanium.

'Rapid Methods of Quantitative Analysis of Rutile/Anatase Mixtures.' By W. Hughes, Ph.D., and H. Smith, M.Sc.

In the titanium pigment industry the estimation of rutile and anatase was required quickly and accurately. X-ray powder diffraction methods were invariably used. A simple camera was described which, based on the flat powder layer method was easy to construct and resulted in a tenfold reduction in exposure times compared with a normal 9 cm. camera. Specimen preparation was simplified, and where large numbers of specimens were involved there was considerable time saving in the treatment of films. The order of accuracy of estimation of either component in rutile/anatase mixtures was about 2 per cent of the total weight of mixture.

Results on rutile/anatase mixtures, obtained by use of a Geiger Counter X-ray spectrometer were described. The accuracy was probably better than 0.5 per cent and the time of determination was seven minutes.

'Surface Area Measurements by the High Vacuum Nitrogen Adsorption Method.' By C. T. Morley Smith, B.Sc., F.R.I.C.

This paper detailed the development, construction and operation of a modification designed primarily for routine work of the apparatus for the determination of the surface area of finely divided materials by the high vacuum nitrogen adsorption method first described by Emmett.

An outline was given on the theoretical concepts and practical evidence on which the method depended, and results were discussed especially in the light of their interpretation in terms of particle size. Various examples were quoted.

German Insecticide Research

WORK on the preparation of compounds leading to the insecticide M 410 has recently been performed in Germany. R. Riemschneider, University of Berlin, describes in six informations (*Zeitschr. f. Naturforschung, Chimie et Industrie*, 1950 and 1951) the preparation, constitution and chemical properties of the compounds $C_{10}H_6Cl_6$ (I) and $C_{15}H_6Cl_{12}$ (II) obtained from hexachlorocyclopentadiene (III) and cyclopentadiene (IV). Several proofs for the constitution of I are given. III reacts as a diene and IV as a philodiene, to form the product I, which is very important for the preparation of M 410. According to the author, the number of the theoretically possible isomers of I is believed to be four (not two).

M 410 is the German abbreviation used since 1945 for the compounds: octachloromethylene-tetrahydrohydrindenes ($C_{10}H_6Cl_8$). Riemschneider and his collaborators have prepared five M 410 isomers from I or the dioxy derivative of I (by direct or indirect chlorinations), with the following melting points: 101-103°C., 102-104°C., 81-84°C., from 73°C., and 137-139°C.

The five isomers show very different insecticidal effects. Not all of them are stereoisomeric. For that reason it is stated that it would be wrong to call them alpha, beta, gamma, delta and epsilon-M 410. As their stereochemistry has not yet been investigated, it is advisable to characterise them for the moment by their melting point.

The Chemist's Bookshelf

GRUNDLAGEN DER METALLKUNDE. By George Masing. Third Edition. Springer-Verlag, Berlin. 1951. Pp. VIII + 148. Dm. 12.60.

This intuitive presentation of the fundamentals of metallurgy, which is a collection of the author's university lectures, differs from other textbooks on the same subject by its brevity and its restriction to principles. Technical problems, however, are also outlined. The book appeals therefore chiefly to the beginner and to the great circle of technical and natural scientists who are not directly interested in metallurgical problems but who find that their knowledge of the subject is insufficient.

The book starts with a survey of the problems and covers in eleven systematically arranged chapters a wide range of practical applications of modern metallurgy such as atomic structure, crystalline formation of alloys, thermo-chemical treatment, plastic forming, recrystallisation, behaviour against non-metallic methods of attack, etc. An appended chapter discusses alloys with three or more components. There are 140 illustrations and a good subject list of references but only few references to relative literature. —F.N.

AUTOREN-NAMEN ALS CHEMISCHE BEGRIFFE. By Kurt G. Wagner. Verlag Chemie GmbH. Weinheim. 1951. Pp. 264. Dm. 14.80.

The study of chemical literature supposes the latent knowledge of a great number of chemical conceptions which do not belong to general definitions but are connected with the names of the investigators, discoverers, etc., who named them, for instance, Michler's ketone, the Erlenmeyer synthesis, Nessler's reagent, Ostwald's calorimeter, etc. Not all these notations can be familiar to every chemist, especially if they refer to special items. Neither can boundary scientists, biologists, medical and pharmaceutical men, geologists, geochemists, mineralogists, metallurgists, and so on, be expected to be fully conversant with such expressions.

This small alphabetical dictionary aims at being a handy reference for daily use for such people. It includes some 1,500 references, divided into four groups: 1, theories, laws, rules, equations, numbers, and constants; 2, methods, procedures, reactions, and tests; 3, chemicals, reagents, and substances; 4, apparatus, manipulation, fittings. Short explanations and references to the literature are added to each item deriving from an author's name.—F.N.

TONERDE UND ALUMINIUM. By Wilhelm Fulda and Hans Ginsberg. Part I. Walter de Gruyter & Co., Berlin. 1951. Pp. VIII + 226. Dm. 26.

The authors present in this book a comprehensive report from a scientific standpoint, but its chief merits lie in the fact that it gives as well a full account of modern manufacturing procedure. Part I, now published, deals with aluminium hydroxide (Tonerde), while the second part to follow will be devoted to aluminium production.

In the years after the last war it was obvious that existing processes could still be improved and needed adapting to modern conditions. Apparatus and machinery described are confined to practical and large-scale developments during the last 30 years.

The text is divided into two sections: fusion processes for bauxite and fusion processes for aluminium silicates. The information is drawn from a consensus of modern views, as expressed in the literature, combined with practical experience gained in the authors' work at the Vereinigte Aluminum Werke A.G. (VAW). The book thus contains an unusual amount of factual data, while the practical recommendations made are authoritative. The text is supported by bibliographic notes, 56 illustrations, 66 tables and a number of diagrams. A list of special apparatus and the firms supplying it is appended and the value of the publication is enhanced by a detailed index.—F.N.

HOME

New Chemical Works

A new factory is being erected at Kirkby Trading Estate, Liverpool, for Albright & Wilson, Ltd., chemical manufacturers, of Oldbury, Birmingham. First instalment of this project will provide buildings on 18 acres of the 44-acre site.

Change of Meeting Place

It is announced by the Iron and Steel Institute that owing to the large numbers wishing to attend the Symposium on the Corrosion of Buried Metals the meeting will now be held in the lecture theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2. The date and time (Wednesday, 12 December, starting at 10 a.m.), and the programme remain unchanged.

Title Changed

The title of Mr. C. L. Heller's paper to be presented at the joint meeting of the Society of Public Analysts and other analytical chemists with the Food Group of the Society of Chemical Industry on Wednesday, 5 December, has been altered from 'Bacteriological Standards' to 'Microbiological Standards.'

Patent Office Library

It has been decided to continue the extended hours of opening of the Patent Office Library, at 25 Southampton Buildings, Chancery Lane, London, W.C.2, until 28 December, 1951. The hours are 10 a.m. to 9 p.m. from Monday to Friday, and 10 a.m. to 5 p.m. on Saturdays.

Coconut Oil Cheaper

Reduction in the price of coconut and/or palm kernel acid oil by £4 10s. from £109 10s. to £105 per ton naked ex works was announced by the Ministry of Food on 3 November. The prices of all other unrefined oils and fats and technical animal fats allocated to primary wholesalers and large trade users will remain unchanged for the period 4 November to 1 December. No change will be made in the prices of refined oils and imported animal fats allocated to primary wholesalers and large trade users during the eight-week period ending 29 December.

Building Trades Exhibition

THE CHEMICAL AGE will be represented on the stand of its proprietors, Benn Brothers Ltd., at the Building Trades Exhibition which opens at Olympia, London, on Wednesday next, 14 November. The stand number is 340, Row T in the National Hall, and a telephone (RENown 4256) has been installed for the convenience of clients.

Second Plastics Exhibition

In response to the requests of a majority of those who took part in the first British Plastics Exhibition and Convention held at Olympia, London, in June this year, it has been decided to hold a similar display and conference in 1953. Exact dates will be announced later, and the event will again have the full support and co-operation of the British Plastics Federation as it did this year.

Nitrogen Prospects

Total production of nitrogen for the year ending 30 June next is estimated at 5,076,000 metric tons compared with 4,725,000 tons in the previous 12 months, while consumption is put at 5,150,000 tons as against 4,850,000 tons according to the annual report of Aikman (London), Ltd. During the next few years production and consumption are expected to balance as production is being increased to meet an expected rise in demand. A feature of the nitrogen market during the last year was the greater quantity consumed by the U.S.A.

Society of Public Analysts

The seventh annual general meeting of the Physical Methods Group of the society will be held in the meeting room of the Chemical Society, Burlington House, Piccadilly, London, W.1, on Tuesday, 27 November, at 6 p.m., and will be followed by the 34th ordinary meeting of the group at which the retiring chairman, Mr. B. S. Cooper, B.Sc., F.Inst.P., will deliver an address on 'Light Sources in Chemical Analysis and Testing'. The annual general meeting is confined to members, but visitors will be welcome at the ordinary meeting held beforehand.

OVERSEAS

Canada's Sulphur Shortage

Hopes that Canada would be able to overcome her sulphur shortage by 1953, were expressed recently by Dr. J. Richardson Donald, director of the Chemicals and Explosives Division of the Defence Production Department, in an address in Montreal to the Commercial Chemical Development Association. Thanks to help from the U.S.A. and to her own efforts, Dr. Richardson forecasts an increase of 100,000 tons in Canadian sulphur production next year.

U.S. Extends Export Licences

Validity of export licences that should have expired on 18 October has been extended by the U.S. Commerce Department because of the dock strike in New York. These licences covering shipments of scarce and strategic materials from Atlantic coast ports will be valid for the duration of the strike plus 30 days.

Liquid Helium in Australia

The possibility of research in Australia in the important field of low temperature physics has been opened up by the attainment recently of −270°C., or 3 degrees above absolute zero, with liquid helium. Liquefaction of the helium was carried out at the rate of half a gallon per hour in a cryostat at the National Standard Laboratory of the Commonwealth Scientific and Industrial Research Organisation (Physics Division). The properties of liquid helium at 2 degrees above absolute zero are peculiar in that it has zero viscosity and an ability to conduct heat almost instantaneously.

U.S. Carbon Black Quota

A fourth-quarter export quota of 32,500,000 lb. of furnace carbon black, the same as for the previous three months, has been announced by the Office of International Trade, Washington. Export of 7,000,000 lb. of S.R.F. (semi-reinforcing) grade has been authorised. This was 1,000,000 lb. better than the third quarter, and was possible because of an easing in supply. Thermal black, however, remains restricted and exports for the final quarter of the year are limited to 4,000,000 lb.

Spark Plug Fouling Eliminated

A new aviation petrol ingredient developed by the Shell Oil Company of America is claimed to abolish spark plug fouling almost completely. The additive is an organic phosphate, reports say, which react with the deposits conducting across insulated parts of the plug to give a compound which is non-conducting at normal engine temperatures. Although the new additive looks very promising, several months of continuous flight testing are required yet before final quantitative results can be obtained.

New Fire Extinguisher

Chlorobromomethane (CH_2ClBr) is now being manufactured on a commercial scale by Eston Chemicals Inc. of America. It is reported to be more than twice as efficient as carbon tetrachloride, and large-scale tests made by the U.S. Navy and Army Air Forces have indicated that this material is particularly effective for fighting magnesium, incendiary and electrical fires.

Canadian Aluminium Increased

The first five months of this year showed aluminium production in Canada to be up 4 per cent in tonnage (15 per cent in value) over the same period in 1950. However, shipments to the U.S. were 17 per cent lower, while Britain's imports increased by 17 per cent. Other countries received more than 60 per cent more than last year. Annual production in Canada, at the present rate, will be 390,000 tons in 1951.

Two Heaviest Isotopes

The two heaviest atoms in existence have recently been made at the University of California in the form of isotopes of the last two elements to be discovered—Berkelium and Californium. The isotopes are Berkelium^{245} and Californium^{246}, and they were produced by bombardment in a cyclotron. These two elements have atomic numbers 97 and 98, the fifth and sixth of the new elements synthesised by nuclear fission. Scientists believe that another five more may yet be added to the list some day.

Publications & Announcements

CHEMICAL works, laboratories, and factories are making increasing use of Dexion slotted angle equipment for racks, benches, shelves and many other applications. Dexion angle is economical for making all kinds of structures. Equipment no longer required can be dismantled and the parts used for some other purpose. A special exhibition to display the wide scope of Dexion structures was held at Church House, Westminster, recently.

* * *

THE Rohm & Haas 'Reporter', journal of the Rohm & Haas Company, of Philadelphia, is now available in its May-June 1951 edition. It contains interesting articles on a range of branches covered by the company, including the development of a new ion-exchange resin for removing sodium in the intestine from the diet of sufferers from dropsy (edema) instead of by denying them salt; the tanning of pigskins; extruded plexiglass panels for eliminating sun glare of various types, and the manufacture of textiles for lingerie, in all of which subjects the products of the company play a part.

* * *

THE 1951 editions of two well-known directories have just been published. The first of these is 'The Chemical Manufacturers' Directory,' which has been published without interruption for 83 years and which sells for 8s. post free. It consists of an index to advertisers' specialities, a classified list of chemicals showing the makers of each kind, a list of chemical brokers and agents in London, and catalogues of chemical manufacturers in England, Wales, Scotland and Ireland, showing the main products of each.

The other is the 'Soap Makers' Directory,' which was established in 1888 and sells for 5s. post free. It contains an index showing the makers of the principal kinds of soaps, and alphabetically arranged lists of soap makers in London, the provinces, Scotland and Ireland. The 'Candle Makers' Directory,' which is included, is similarly arranged.

Both directories can be obtained from Simpkin Marshall (1941), Ltd., or direct from the publishers, Newnham, Cowell & Gripper, Ltd., 15 City Road, London, E.C.1.

THE Shell Magazine for November, 1951, is now available. This issue, besides the usual appointments and retirements, obituaries and staff movements, contains a well illustrated article on Oxford University (past and present), an article on Shell's Australian Jubilee celebrated this year, one on the Shell Berre Refinery at Berre-l'Etang, near Marseilles, and an account of Egypt's oil. A very interesting and well brought out journal this, it is profusely illustrated with excellent photographs (all taken by members of the company), and includes non-technical book reviews, film reviews, and a survey of recorded music.

* * *

THE fourth annual review of Norway's iron and metal products exports (entitled *Norway*) has recently come to hand. At the present time Norway's exports of iron and metal products, including machinery, are limited in relation to total exports, most of the products of this branch of their industry going to supply home demand and specialising in machines and equipment for the processing of domestic raw materials. The iron and metal-working branch is, however, the most important segment of Norway's industry, both in regard to employment and production. It employs 32 per cent of industrial workers and accounts for 20 per cent of the value of the country's gross annual production. *Norway* covers the various products which this branch offers, or intends to offer, for export.

* * *

KESTNER Evaporation and Engineering Co., Ltd., have recently issued two leaflets, one describing their axial flow fans for corrosive gases, and the other acid recovery plant. The acid recovery plant is for recovering pickling acid and ferrous sulphate, and does not involve either refrigeration or evaporation plant. By maintaining free acid concentration in the pickling bath at a high level it is possible to allow a higher concentration of ferrous sulphate in the bath than normally. At a certain concentration the pickle liquor is sent for recovery, the sulphate removed by direct crystallisation using normal cooling water at 15-20°C., and the mother liquor re-heated and sent back to the pickling plant.

· PERSONAL ·

MR. E. J. WILSON, until recently assistant engineer to the Port of London Authority, has been appointed by Richard Sutcliffe, Ltd., to be manager of its London office.

DR. D. G. SOPWITH, acting director of mechanical engineering research at the National Physical Laboratory, has been appointed director of mechanical engineering research in succession to the late Dr. G. A. Hankins. Dr. Sopwith, who is 45, will be in charge of the new mechanical engineering research organisation, of which the new laboratories are at present under construction at East Kilbride, near Glasgow.

MR. E. H. DISCOMBE, a delegate director and commercial manager of Murex Welding Processes, Ltd., Waltham Cross, Herts, has retired after over 35 years' service with the company. Before leaving he was presented with a cheque on behalf of the staff by MR. H. J. PENN, managing director, who paid tribute to his work as an executive of the firm. Mr. Discombe was a founder-member of the Premier Electric Welding Co., Ltd., in 1918, and was its first secretary and later, assistant manager. With the amalgamation of the company with Murex Welding Processes, Ltd., he took up the position of commercial manager and later became a delegate director. Mr. Discombe is one of the earliest members of the Institute of Welding.

The appointment of MR. P. J. C. BOVILL, B.Sc., local director, and general manager of the chemicals branch of Newton Chambers & Co., Ltd., to be a vice-chairman of the local board was recently announced by SIR HAROLD WEST, the managing director, at a management conference. Mr. Bovill, who was educated at Cheltenham College and graduated in fuel technology at Sheffield University, has spent the greater part of his business life with Newton Chambers and its subsidiaries.

The appointment of MR. S. S. C. MITCHELL to be Controller of Guided Weapons and Electronics in succession to AIR CHIEF MARSHALL SIR ALEC CORYTON is announced by the Ministry of Supply.

MR. PETER COLE, a newly-appointed director of R. H. Cole & Co., Harpenden, chemical manufacturers, left London Airport by BOAC Stratocruiser for Montreal on 26 October. This visit, his third to North America, is on business connected with raw materials for paint and plastics. He plans to be away for four weeks and, after visiting several Canadian cities, will fly back to London via New York.

Mr. P. Cole

It was announced in New York this week that DR. L. B. PARSONS is to be director of research and development for Lever Brothers Company. Dr. Parsons joined Lever Brothers as a research supervisor in 1939 and served successively as chief chemist, manager of basic research laboratories, and assistant director of research and development. He will continue to be located at the Lever research laboratories in Cambridge, Mass.

Dr. Parsons was graduated from Syracuse University in 1919 and received a Master of Science degree in 1921 at the University of Wisconsin and a Ph.D. degree in 1923. He then became associated with the Cudahy Packing Company and was research director when he resigned in 1939 to join Lever Brothers.

A member of the American Chemical Society, the American Oil Chemists' Society, the American Association for the Advancement of Science, and the American Society for Testing Materials, Dr. Parsons has been active in the affairs of the American Chemical Society in the Omaha and North-Eastern sections, and has served as vice-president for the soap and detergents section of the American Oil Chemists' Society for several years. He has also served eight years on the committee on soap and detergents of the American Society for Testing Materials. He succeeds DR. THEODORE H. RIDER, who resigned recently because of illness.

Commercial Intelligence

The following are taken from the printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

Satisfaction

ALUMINIUM CORPORATION LTD., Dolgarrog. (M.S., 10/11/51.) Satisfaction 1 October, of debentures registered 19 July, 1930.

EXCELL THOMAS LTD., Swansea, dealers in chemicals. (M.S., 10/11/51.) Satisfaction 27 September, of charge registered 6 April 1936.

Increases of Capital

The following increases of capital have been announced: FAIRBANK KIRBY, LTD., from £12,000 to £17,000.

New Registration

Prior Chemicals, Ltd.

Private company. (500,695). Capital £1,000. Manufacturing, research, dispensing and analytical chemists and druggists, etc. Directors: E. J. R. Lovelock and C. H. Mellor. Reg. office: Picton Street, Salford 7.

Company News

Fisons, Ltd.

Purchase of fertilisers for reserve stocks in anticipation of further price rises helped to increase sales and add to the trading profit of Fisons, Ltd., in the year ended 30 June. Higher profits were also contributed by the British Chemicals and Biological Groups. With the recommendation of a final dividend of 6 per cent, the distribution on the £4,438,556 ordinary capital is brought up to 9 per cent, as for the previous 12 months. Net profit of the group, after all charges, expanded by £210,527 to £781,307. The meeting will be held at Ipswich, at noon on 3 December.

A.P.V. Issue

Approximately £1,000,000 is to be raised by the A.P.V. Co., Ltd., makers of specialised process plant and equipment in stainless steel. The Capital Issues Committee has agreed to the issue of 500,000 new 10s. ordinary shares at 15s. 6d. per share in the proportion of one for three, and the private placing of £650,000 4¼ per cent loan stock, 1957-61, at 99 per cent. Both the private placing and the issue to shareholders are being made under the auspices of Seligman Brothers, with Cuzenove Akroyds and Greenwood & Co. acting as brokers.

Market Reports

LONDON.—There has been little change in the industrial chemical market either in conditions or prices during the past week.

An active inquiry has been reported in all sections and the demand for products in short supply remains persistant while there has been a renewed interest in new contract business for the routine chemicals. Export inquiry is reported to be well up to recent levels. The demand for the coal tar products continues brisk and the quantities coming on to the market are quickly absorbed. Pitch, pyridine and naphthalene are strong while creosote oil and cresylic acid remain firm on a steady demand.

MANCHESTER.—The general strength of the market has been good and inquiries for heavy chemicals have been well maintained. Business has not always been possible because in many sections of the trade available supplies have already been disposed of for some time ahead and in consequence there is difficulty in spot or near delivery. Existing contracts are being drawn against steadily. Movement of fertilisers has improved, and a brisk demand continues for most of the tar products.

GLASGOW.—The usual shortages continue but supplies of some of the metal derivatives have been more plentiful. Generally speaking, it has been a fairly quiet week. In overseas trade the demand for alkalis remains steady and considerable interest is being shown in insecticides. There is the usual regular demand for the ordinary run of general chemicals and a steady business is being maintained.

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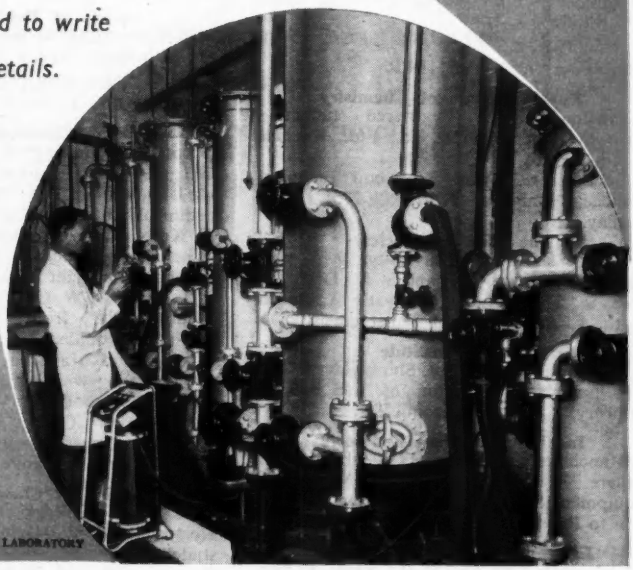

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Next Week's Events

MONDAY 12 NOVEMBER

Royal Institute of Chemistry

London: Polytechnic, Manresa Road, S.W.3, 6.30 p.m. (with Chelsea Polytechnic Chemical Society). Dr. R. K. Schofield: 'Some Aspects of Colloid Chemistry Applied to Soil Science'.

Incorporated Plant Engineers

Dundee: Mathers Hotel, 7.30 p.m. 'Factory Instrumentation,' Talk and film by Bristol's Instrument Co

Institute of Packaging

Manchester: Grand Hotel, 6.30 p.m. Northern Area meeting. T. F. Boyle (British Schering Manufacturing Laboratories, Ltd.) and A. F. Much (I.C.I., Ltd., Packages Advisers Section): 'Development of a Package for a New Product'.

Purchasing Officers' Association

London: 'Royal Society of Arts,' John Adam Street, Adelphi, W.C.2, 7.30 p.m. Dr. E Voce (chief metallurgist, Copper Development Association): 'Production and Uses of Copper'. Film: 'Copper Belt of Northern Rhodesia'.

TUESDAY 13 NOVEMBER

Royal Institute of Chemistry

London: 2 p.m. Registered students—Visit to Peek Frean & Co., Ltd., Keetons Road, S.E.16.

London: 6.30 p.m. Norwood Technical College, Knight's Hill, S.E.27. Film display.

The Chemical Society

Belfast: Queen's University, 7.15 p.m. Joint meeting with RIC and SCI. Dr. V. C. Barry: 'The Organic Chemist's Approach to the Chemotherapy of Tuberculosis'.

Textile Institute

Glasgow: Institute of Shipbuilders, 7.30 p.m. (with the Institution of the Rubber Industry). Film on 'Atomic Physics'.

Incorporated Plant Engineers

Manchester: Engineers' Club, Albert Square, 7.15 p.m. L. Manuel (Metallising Equipment Co., Ltd.): Metallising in Relation to Plant Engineering'.

Liverpool Metallurgical Society

Liverpool: City Technical College, Byrom Street (with Institute of Welding). Professor E. C. Rollason: 'Welding Metallurgy'.

WEDNESDAY 14 NOVEMBER

Society of Chemical Industry

London: The Craigmillar and British Creameries, Ltd., Sussex House, Queen Street, E.C.4, 6-9.30 p.m. Food and Agricultural Groups' Conversazione. Demonstration of flour confectionery work, exhibits of processed foods, etc. Film of the Food Groups' summer tour to Northern Italy.

Institution of Chemical Engineers

Oldbury: 2 p.m. Graduates' and students' section, Midlands Centre. Visit to Midland Tar Distillers, Ltd.

Pontypool: 2 p.m. Graduates' and students' section, South Wales Centre. Visit to British Nylon Spinners, Ltd.

Textile Institute

Macclesfield: Elizabeth St. Canteen, Wm. Frost & Sons, Ltd., 8 p.m. B. P. Ridge (I.C.I., Ltd., Plastics Division): 'The New Textiles'.

Institute of Fuel

Chester: Grosvenor Hotel, 7.30 p.m. W. C. Carter: 'Modern Steam Generators'.

Society of Public Analysts

Glasgow: Central Hotel, 7.15 p.m. Reading of original papers.

THURSDAY, 15 NOVEMBER

The Chemical Society

London: Burlington House, Piccadilly, W.1, 7.30 p.m. Reading of original papers. E. J. Bowen: 'The Photochemical Interaction of Anthracene and Alkyl Chlorides'; K. Knox, R. G. W. Norrish and G. Porter: 'The Photochemical Decomposition of Ketene using Light of Very High Intensity'; P. J. Dyne, D. W. G. Style and J. C. Ward: 'Fluorescence from Formic Acid and Methylene Iodide'.

Aberdeen: Marischal College, 7.30 p.m. Joint meeting with RIC and SCI. Professor A. Robertson: 'Mould Metabolic Products'.

Manchester: College of Technology, 6.30 p.m. Joint meeting with RIC and SCI. Dr. T. S. Stevens; 'Anatomy of the Chemist'.

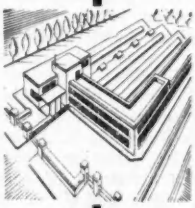
Institution of Chemical Engineers

Bradford: College of Technology, Gt. Horton Road, 7.30 p.m. Graduates' and students' section, Yorkshire Centre. J. J. Priestley: Organic Sulphur Removal from Town's Gas'.

[continued on page 648

an important change of address

Please note that our London Area and Export Offices and Warehouse have moved to new premises at Ealing Road, Alperton. Our Birmingham address remains unchanged.



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The Royal Society

London: Burlington House, Piccadilly, W.1, 4.30 p.m. E. N. da C. Andrade, F.R.S., and C. Henderson: 'The Mechanical Behaviour of Single Crystals of Certain Metals'; D. W. Pashley: 'Orientated Chemical Overgrowths and Surface Topography'.

Pharmaceutical Society

Manchester: Milton Hall, Deansgate, 7.45 p.m. (with Women Pharmacists' Association). R. J. Hobbs, Ph.C.: 'The New Antibiotics', illustrated by lantern slides.

FRIDAY 16 NOVEMBER

Society of Chemical Industry

London: Middlesex Hospital Medical School, 7 p.m. C. R. Ricketts, Ph.D. (scientific staff, Medical Research Council) and K. W. Walton, M.D. (lecturer, Department of Pathology, University of Birmingham): 'Blood Anticoagulants with Special Reference to Dextrin Sulphate'.

Swansea: The Guildhall, 6.30 p.m. Jubilee Memorial Lecture. E. M. Myers: 'The Upgrading of Minerals with Special Reference to Coal'.

The Chemical Society

Glasgow: Royal Technical College, 7.15 p.m. Dr. G. Baddeley: 'Aluminium Halide as a Reagent in Organic Chemistry'.

St. Andrews: United College, 5.15 p.m. Professor R. P. Linstead: 'The Transfer of Hydrogen between Organic Compounds'.

Southampton: University College, 5 p.m. Lecture by Dr. H. C. Longuet-Higgins.

Institution of Chemical Engineers

London: Caxton Hall, Westminster, S.W.1, 6.30 p.m. Graduates' and students' section. P. F. Corbett (Graduate): 'Some Water Tube Boiler Problems'.

Society of Public Analysts

London: 4 Grosvenor Gardens, S.W.7, 6 p.m. Polarographic Discussion Panel, Physical Methods Group, annual general meeting. E. R. Roberts and J. S. Meek: 'The Vibrating Electrode in Polarographic Determination of Alkyl Peroxides'; K. C. Overton and J. A. Lewis: 'A Recording Polarograph for Continuous Flow Operation'; G. F. Reynolds and H. M. Davis: 'An Improved Randles Type Cathode Ray Polarograph'.

The Royal Institution

London: 21 Albemarle Street, W.1, 9 p.m. T. E. Allibone, D.Sc., F.R.S. (in charge of Research Laboratory, Associated Electrical Industries, Ltd., Aldermaston): 'New Materials in Engineering'.

Canadian Liquid SO_2 Plant

CONSTRUCTION has started by Canadian Industries, Ltd., on a liquid sulphur dioxide plant at Copper Cliff, Ont. The plant is being erected by Fraser Brace Engineering Co. (Ont.), Ltd., and cost of the project has not been disclosed. When completed next autumn the plant will have an initial capacity of over 90,000 tons of liquid sulphur dioxide destined for use by newsprint, sulphite pulp and other manufacturers who now have to depend upon elemental sulphur imported from the United States. Each ton of the liquid product can replace half a ton of imported sulphur. This will be the second plant at Copper Cliff which uses for a basic raw material nothing more nor less than waste fumes from the International Nickel Company's smelter. A Candian Industries' plant there has been producing sulphuric acid from these gases for many years. An expansion expected to be in operation shortly will enable production of the acid to be increased by about 60 per cent.

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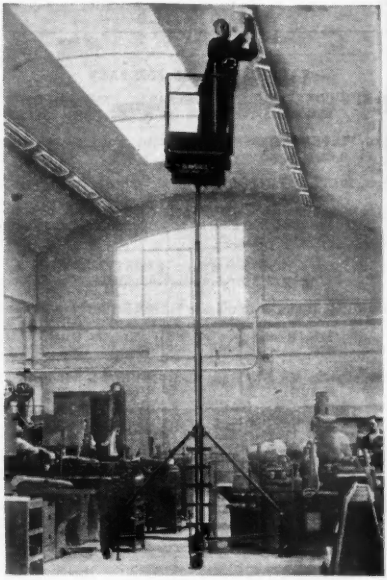

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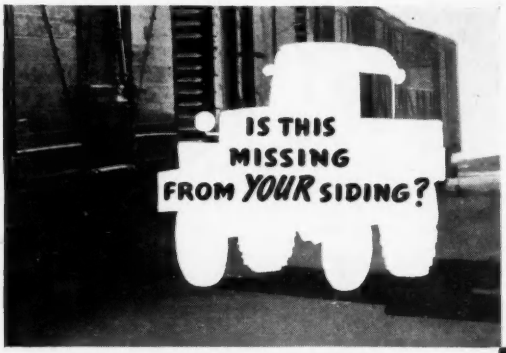

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